

UNIVERSITY OF SOUTHAMPTON

# Uncertainty in Morphological Sediment Budgeting of Rivers

by

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# Bibliography

- Addin OM & Jensen FV (2004), *Bayesian Belief Networks in Environmental Decision Support Systems*, Technical report, Centre for Ecology and Hydrology, Wallingford, UK.
- Allison RJ & Thomas D (1993), 1. The Sensitivity of Landscapes, in: *Landscape sensitivity: British Geomorphological Research Group symposia series* (Edited by Thomas D & Allison R), John Wiley and Sons, Chichester, U.K., pp. 1–5.
- Anderson JL (1998), Chapter 6: Errors of Inference, in: *Statistical Methods for Adaptive Management Studies* (Edited by Sit V & Taylor B), B.C. Ministry of Forests, Victoria, B.C., volume Land Management Handbook No. 42, pp. 69–87.
- Anderson JL, Hilborn R, Lackey RT & Ludwig D (2003), 9. Watershed Restoration- Adaptive Decision Making in the Face of Uncertainty, in: *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems* (Edited by Wissmar RC, Bisson PA & Duke M), American Fisheries Society, Bethesda, Maryland, 1st edition, pp. 185–201.
- AP (2005), New Year's Storm Brings Flooding to Bay Area, *The Associated Press*, (Dec 31).
- Arcsott DB, Tockner K, van der Nat D & Ward JV (2002), Aquatic habitat dynamics along a braided alpine river ecosystem (Tagliamento River, Northeast Italy), *Ecosystems*, **5**(8): 802–814.
- Ayyub B & Gupta M, eds. (1994), *Uncertainty Modelling and Analysis: Theory and Applications*, Elsevier Science, The Netherlands.
- Balakrishnan S, Roy A, Ierapetritou MG, Flach GP & Georgopolous PG (2003), Uncertainty reduction and characterization for complex environmental fate and transport models: An empirical Bayesian framework incorporating the stochastic response surface method, *Water Resources Research*, **39**(12): 1350.
- Ballantyne CK & Whittington G (1999), Late Holocene floodplain incision and alluvial fan formation in the central Grampian Highlands, Scotland: chronology, environment and implications, *Journal of Quaternary Science*, **14**(7): 651–671.
- Baltsavias EP (1999), A comparison between photogrammetry and laser scanning, *Photogrammetry and Remote Sensing*, **54**: 83–94.
- Bandemer H & Gottwald S (1995), *Fuzzy Sets, Fuzzy Logic, Fuzzy Methods: with Applications*, John Wiley and Sons, Chichester, U.K., 239 pp.
- Barinaga M (1996), Ecology: A Recipe for River Recovery?, *Science*, **273**(5282): 1648–1650.
- Bash J & Ryan C (2002), Stream restoration and enhancement projects: Is anyone monitoring?, *Environmental Management*, **29**(6): 877–885.
- Batalla R, Vericat D & Palau A (2006), Sediment transport during a flushing flow in the lower Ebro, in: *Sediment Dynamics and the Hydromorphology of Fluvial Systems* (Edited by Rowan J, Duck R & Werritty A), IAHS Press, Wallingford, UK, volume 306, pp. 132–142.
- Beckinsale RP (1976), The International Influence of William Morris Davis, *Geographical Review*, **66**(4): 448–466.

- Beechie TJ, Collins BD & Pess GR (2001), Holocene and Recent Geomorphologic Processes, Land Use, and Salmonid Habitat in two North Puget Sound River Basins, in: *Geomorphic Processes and Riverine Habitat* (Edited by Beechie T, Collins BD & Pess G), American Geophysical Union, Washington D.C., volume Water Science and Application Volume 4, pp. 37–54.
- Beechie TJ, Greene CM, Holsinger L & Beamer EM (2006), Incorporating parameter uncertainty into evaluation of spawning habitat limitations on Chinook salmon (*Oncorhynchus tshawytscha*) populations, *Canadian Journal of Fisheries and Aquatic Sciences*, **63**(6): 1242–1250.
- Bergerud WA & Reed J William (1998), Bayesian Statistical Methods, in: *Statistical Methods for Adaptive Management Studies* (Edited by Sit V & Taylor B), Research Branch, B.C. Ministry of Forests, Victoria, B.C., volume Land Management Handbook No. 42, pp. 89–104, sEE 6503.
- Berkes F (2007), Understanding uncertainty and reducing vulnerability: lessons from resilience thinking, *Natural Hazards*, **41**(2): 283–295.
- Bernhardt ES, Palmer MA, Allan JD, Alexander G, Barnas K, Brooks S, Carr J, Clayton S, Dahm C, Follstad-Shah J, Galat D, Gloss S, Goodwin P, Hart D, Hassett B, Jenkinson R, Katz S, Kondolf GM, Lake PS, Lave R, Meyer JL, O'Donnell TK, Pagano L, Powell B & Sudduth E (2005), Synthesizing US river restoration efforts, *Science*, **308**(5722): 636–637.
- Beven K (1996a), Equifinality and Uncertainty in Geomorphological Modelling, in: *The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology* (Edited by Rhoads BL & Thorn CE), John Wiley and Sons, Chichester, U.K., pp. 289–314.
- Beven K (1996b), The limits of splitting: Hydrology, *The Science of the Total Environment*, **183**: 89–97.
- Beven K & Binley AM (1992), The future of distributed models: model calibration and uncertainty prediction, *Hydrological Processes*, **6**: 279–298.
- Bibby R, Reeves G & Dolloff CC (2003), 6. Sources of Variability in Aquatic Ecosystems: Factors Controlling Biotic Production and Diversity, in: *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems* (Edited by Wissmar RC, Bisson PA & Duke M), American Fisheries Society, Bethesda, Maryland, 1st edition, pp. 129–146.
- Binley AM, Beven KJ, Calver A & Watts LG (1991), Changing Responses in Hydrology - Assessing the Uncertainty in Physically Based Model Predictions, *Water Resources Research*, **27**(6): 1253–1261.
- Blanchard J (2006), NEW YEARS STORM: HISTORIC REGIONAL FLOODING, *San Francisco Chronicle*, (January 1): A–11.
- Bluck BJ (1976), Sedimentation in Some Scottish Rivers of Low Sinuosity, *Transactions of the Royal Society of Edinburgh*, **69**: 425–456.
- Bradford MJ, Korman J & Higgins PS (2005), Using confidence intervals to estimate the response of salmon populations (*Oncorhynchus* spp.) to experimental habitat alterations, *Canadian Journal of Fisheries and Aquatic Sciences*, **62**(12): 2716–2726.
- Brasington J, Langham J & Rumsby B (2003), Methodological sensitivity of morphometric estimates of coarse fluvial sediment transport, *Geomorphology*, **53**(3–4): 299–316.
- Brasington J, Rumsby BT & Mcvey RA (2000), Monitoring and modelling morphological change in a braided gravel-bed river using high resolution GPS-based survey, *Earth Surface Processes and Landforms*, **25**(9): 973–990.
- Brasington J & Smart R (2003), Close Range Digital Photogrammetric Analysis of Experimental Drainage Basin Evolution, *Earth Surface Processes and Landforms*, **28**: 231–247.
- Brasington J, Wheaton J & Williams RD (2004), Sub-Reach Scale Morphological Interpretations from DEM Differencing: Accounting for DEM Uncertainty, *Eos Trans. AGU*, **85**(47): Fall Meeting Supplement, Abstract H43A–0352.
- Brasington J, Wheaton JM, Vericat D & Hodge R (2007), Modelling Braided River Morphodynamics With Terrestrial Laser Scanning, *Eos Trans. AGU*, **88**(52): Fall Meet. Suppl., Abstract H51L–02.
- Brazier RE, Beven KJ, Anthony SG & Rowan JS (2001), Implications of model uncertainty for the mapping of hillslope-scale soil erosion predictions, *Earth Surface Processes and Landforms*, **26**(12): 1333–1352.

- Brazier RE, Beven KJ, Freer J & Rowan JS (2000), Equifinality and uncertainty in physically based soil erosion models: Application of the glue methodology to WEPP-the water erosion prediction project-for sites in the UK and USA, *Earth Surface Processes and Landforms*, **25**(8): 825–845.
- Brazier V & Ballantyne C (1989), Late Holocene debris cone evolution in Glen Feshie, western Cairngorm Mountains, Scotland, *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **80**: 17–24.
- Bremner A (1915), The capture of the Geldie by the Feshie, *Scottish Geographical Magazine*, **31**: 589–596.
- Brewer PA & Passmore DG (2002), Sediment budgeting techniques in gravel bed rivers, in: *In Sediment Flux to Basins: Causes, Controls and Consequences, Special Publication 191* (Edited by S J & Frostick L), Geological Society, London, pp. 97–113.
- Brierley G & Fryirs K (2005), *Geomorphology and River Management: Applications of the River Styles Framework*, Blackwell Publishing, Victoria, Australia, 398 pp.
- Brierley GJ & Fryirs K (2000), River styles, a geomorphic approach to catchment characterization: Implications for river rehabilitation in Bega catchment, New South Wales, Australia, *Environmental Management*, **25**(6): 661–679.
- Brookes A, Downs P & Skinner K (1998), Uncertainty in the engineering of wildlife habitats, *Journal of the Chartered Institution of Water and Environmental Management*, **12**(1): 25–29.
- Brookes A, Knight SS & Shields FD (1996), 4. Habitat Enhancement, in: *River Channel Restoration: Guiding Principles for Sustainable Projects* (Edited by Brookes A & Shields FD), John Wiley and Sons, Chichester, UK, pp. 103–126.
- Brooks SM & McDonnell RA (2000), Research advances in geocomputation for hydrological and geomorphological modelling towards the twenty-first century, *Hydrological Processes*, **14**(11-12): 1899–1907.
- Brown I & Clapperton C (2002), The Physical Geography, in: *The Ecology, Land Use and conservation of the Cairngorm* (Edited by Gimingham C), Packard, Chichester, pp. 8–20.
- Brown T, LeMay HE & Bursten B (1994), *Chemistry: The Central Science*, volume Sixth Edition, Prentice Hall, Englewood Cliffs, NJ, 1045 pp.
- Brunke M (1999), Colmation and Depth Filtration within Streambeds: Retention of Particles in Hyporheic Interstices, *International Rev. Hydrobiology*, **84**(2): 9–117.
- Brunsdon D (1993), 2. Barriers to Geomorphological Change, in: *Landscape sensitivity: British Geomorphological Research Group symposia series* (Edited by Thomas D & Allison R), John Wiley and Sons, Chichester, U.K., pp. 7–12.
- Bunte K & Abt SR (2001), *Sampling Surface and Subsurface Particle-Size Distributions in Wadable Gravel- and Cobble-Bed Streams for Analyses in Sediment Transport, Hydraulics and Stream Bed Monitoring. Gen. Tech. Rep. RMRS-GTR-74*, Technical Report RMRS-GTR-74, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.
- Burrough PA & McDonnell RA (1998), *Principles of Geographical Information Systems: Spatial Information Systems and Geostatistics*, Oxford University Press, Oxford, 333 pp.
- Cao Z & Carling PA (2002a), Mathematical modelling of alluvial rivers: reality and myth. Part 2: Special issues, *Proceedings of the Institution of Civil Engineers-Water and Maritime Engineering*, **154**(4): 297–307.
- Cao Z & Carling PA (2002b), Mathematical modelling of alluvial rivers: reality and myth. Part I: General review, *Proceedings of the Institution of Civil Engineers-Water and Maritime Engineering*, **154**(3): 207–219.
- Carbonneau PE, Lane SN & Bergeron NE (2003), Cost-effective non-metric close-range digital photogrammetry and its application to a study of coarse gravel river beds, *International Journal of Remote Sensing*, **24**(14): 2837–2854.
- Cardwell H & Ellis H (1996), Model uncertainty and model aggregation in environmental management, *Applied Mathematical Modelling*, **20**(2): 121–134.
- Carling PA, Cao ZX, Holland MJ, Ervine DA & Babaeyan-Koopaei K (2002), Turbulent flow across a natural compound channel, *Water Resources Research*, **38**(12): art. no.–1270.

- Carson MA & Griffiths GA (1989), Gravel Transport in the Braided Waimakariri River - Mechanisms, Measurements and Predictions, *Journal of Hydrology*, **109**(3-4): 201–220.
- CDFG (1991), *Lower Mokelumne River Fisheries Management Plan*, Technical report, California Department of Fish and Game: The Resources Agency, Sacramento, CA.
- Chandler J, Ashmore P, Paola C, Gooch M & Varkaris F (2002), Monitoring River-Channel Change Using Terrestrial Oblique Digital Imagery and Automated Digital Photogrammetry, *Annals of the Association of American Geographers*, **92**(4): 631–644.
- Chapman C & Ward S (2002), *Managing Project Risk and Uncertainty: A Constructively Simple Approach to Decision Making*, John Wiley and Sons, Chichester, U.K., 512 pp.
- Chapman D (1988), Critical Review of Variables Used to Define Effects of Fines in Redds of Large Salmonids, *Transactions of the American Fisheries Society*, **117**: 1–21.
- Chappell A, Heritage GL, Fuller IC, Large ARG & Milan DJ (2003), Geostatistical analysis of ground-survey elevation data to elucidate spatial and temporal river channel change, *Earth Surface Processes and Landforms*, **28**(4): 349–370.
- Charlton ME, Large ARG & Fuller IC (2003), Application of airborne LiDAR in river environments: The River Coquet, Northumberland, UK, *Earth Surface Processes and Landforms*, **28**(3): 299–306.
- Chen S, Nikolaidis E, Cudney HH, Rosca R & Haftka RT (1999a), *Comparing Probabilistic and Fuzzy Set Approaches for Design in the Presence of Uncertainty*, Ph.d. dissertation, American Institute of Aeronautics and Astronautics, Blacksburg, Virginia.
- Chen S, Nikolaidis E, Cudney HH, Rosca R & Haftka RT (1999b), *Comparison of Probabilistic and Fuzzy Set Methods for Designing under Uncertainty*, Technical Report AIAA-99-1579, American Institute of Aeronautics and Astronautics.
- Church M (1996), Space, Time and the Mountain - How Do We Order What We See?, in: *The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology* (Edited by Rhoads BL & Thorn CE), John Wiley and Sons, Chichester, U.K., pp. 147–170.
- Church M (2002), Geomorphic thresholds in riverine landscapes, *Freshwater Biology*, **47**(4): 541–557.
- Church M (2006), Bed material transport and the morphology of alluvial river channels, *Annual Review of Earth and Planetary Sciences*, **34**: 325–354.
- Church M, Ham D & Weatherly H (2001), *Gravel Management in the Lower Fraser River*, Technical report, Department of Geography, The University of British Columbia, Vancouver, British Columbia.
- Church MA & Rood KM (1983), *Catalogue of Alluvial River Channel Regime Data*, Dept. of Geography, University of British Columbia, Natural Sciences and Engineering Research Council, Canada, Vancouver, British Columbia.
- Clark MJ (2002), Dealing with uncertainty: adaptive approaches to sustainable river management, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **12**: 347–363.
- Clark MJ, Newson M, Sear D & Thorne CR (1997), *Geomorphological Approaches to River Management*, Technical Report R D Project 661, Environment Agency, Southampton, UK.
- Clark MJ & Richards KJ (2002), Supporting complex decisions for sustainable river management in England and Wales, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **12**: 471–483.
- Clayton SR (2002), *Quantitative Evaluation of Physical and Biological Responses to Stream Restoration*, Ph.d. dissertation, University of Idaho, Moscow, ID.
- Clifford NJ, Acreman MC & Booker DJ (2008), Hydrological and hydraulic aspects of river restoration uncertainty for ecological purposes, in: *River Restoration: Managing the Uncertainty in Restoring Physical Habitat* (Edited by Darby SE & Sear D), John Wiley and Sons, Chichester, U.K.
- Coronado C & Hilborn R (1998), Spatial and temporal factors affecting survival in coho and fall chinook salmon in the Pacific Northwest, *Bulletin of Marine Science*, **62**(2): 409–425.
- Costanza R, Andrade F, Antunes P, van den Belt M, Boersma D, Boesch DF, Catarino F, Hanna S, Limburg K, Low B, Molitor M, Pereira JG, Rayner S, Santos R, Wilson J & Young M (1998), Principles for sustainable governance of the oceans, *Science*, **281**(5374): 198–199.

- Coulthard T (1999), *Modelling Upland Catchment Response to Holocene Environmental Change*, Unpublished phd thesis, University of Leeds, Leeds, UK.
- Coulthard T (2001), Landscape evolution models: a software review, *Hydrological Processes*, **15**(1): 165–173.
- Cox C, Brasington J, Richards K, Wheaton JM & Williams R (Submitted), A Comparison of Cellular Automata Flow Routing Models, *Earth Surface Processes and Landforms*.
- Cox C, Brasington J & Williams RD (2004), Empirical and Experimental Validation of Channel Dynamics Models, *Eos Trans. AGU*, **85**(47): Fall Meeting Supplement, Abstract H43A-0358.
- Crowder DW & Diplas P (2000), Using two-dimensional hydrodynamic models at scales of ecological importance, *Journal of Hydrology*, **230**(3-4): 172–191.
- Darby SE & Sear D, eds. (2008), *River Restoration: Managing the Uncertainty in Restoring Physical Habitat*, John Wiley and Sons, Chichester, U.K.
- Darby SE & Thorne CR (1996), Modelling the sensitivity of channel adjustments in destabilized sand-bed rivers, *Earth Surface Processes and Landforms*, **21**(12): 1109–1125.
- Davis W (1885), Geographic classification, illustrated by a study of plains plateaus, and their derivatives, *Proceedings of the American Association for the the Advancement of Science*, **33**: 428–432.
- Davis WM (1902), Systematic Geograph, *Proceedings of the American Philosophical Society*, **41**(170): 235–259.
- Davis WM (1915), The Principles of Geographical Description, *Annals of the Association of American Geographers*, **5**: 61–1050.
- Demers MN (1991), Classification and Purpose in Automated Vegetation Maps, *Geographical Review*, **81**(3): 267–280.
- Deng Y (2007), New trends in digital terrain analysis: landform definition, representation, and classification, *Progress in Physical Geography*, **31**(4): 405–419.
- Dinehart RL (1992), Gravel-Bed Deposition and Erosion by Bedform Migration Observed Ultrasonically During Storm Flow, North Fork Toutle River, Washington, *Journal of Hydrology*, **136**(1-4): 51–71.
- Dorava JM, Montgomery DR, Palcasak BB & Fitzpatrick FA (2001), Understanding Geomorphic Processes and Riverine Habitat, in: *Geomorphic Processes and Riverine Habitat* (Edited by Dorava JM, Montgomery DR, Palcasak BB & Fitzpatrick FA), American Geophysical Union, Washington D.C., volume Water Science and Application Volume 4, pp. 3–4.
- Downs PW & Kondolf GM (2002), Post-project appraisals in adaptive management of river channel restoration, *Environmental Management*, **29**(4): 477–496.
- Doyle MW, Boyd KF & Skidmore PB (1999), River restoration channel design: Back to the basics of dominant discharge, in: *Second International Conference on Natural Channel Systems*, Watershed Science Centre, Trent University, Niagra Falls, Canada, p. 12.
- Dunn RA, Scheirer DS & Forsyth DW (2001), A detailed comparison of repeated bathymetric surveys along a 300-km-long section of the southern East Pacific Rise, *Journal of Geophysical Research-Solid Earth*, **106**(B1): 463–471.
- EA (2003), *River Habitat Survey in Britain and Ireland: Field Survey Guidance Manual*, Technical Report River Habitat Survey Manual: 2003 version, Environment Agency.
- Eeckhaut MVD, Poesen J, Verstraeten G, Vanacker V, Moeyersons J, Nyssen J, Beek Lv & Vandekerckhove L (2007), Use of LIDAR-derived images for mapping old landslides under forest, *Earth Surface Processes and Landforms*, **32**(5): 754–769.
- Elkins E, Pasternack GB & Merz JE (2007), The use of slope creation for rehabilitating incised, regulated, gravel bed rivers, *Water Resources Research*, **43**: W05,432.
- Ellison S, Rosslein M & Williams A, eds. (2000), *Quantifying Uncertainty in Analytical Measurement*, volume Guide number 4, Eurachem/CITAC, Teddington, UK, second edition edition.
- Enberg K, Fowler MS & Ranta E (2006), The impacts of different management strategies and environmental forcing in ecological communities, *Proceedings of the Royal Society B-Biological Sciences*, **273**(1600): 2491–2499.

- Envirosphere (1988), *Draft Mokelumne River Fisheries Study*, Technical report, Envirosphere Co. for East Bay Municipal Utility District, Sacramento, CA.
- Evenson (2001), *Egg Pocket Depth and Particle Size Composition within Chinook Salmon Redds in the Trinity River, California*, Masters thesis, Humboldt State University, Humboldt.
- Faulkner W (1994), Conceptualizing Knowledge Used in Innovation: A Second Look at the Science-Technology Distinction and Industrial Innovation, *Science Technology Human Values*, **19**(4): 425–458.
- FEMA (1998), *Flood Insurance Study: City of Saint Helena, California, Napa County*, Technical report, Federal Emergency Management Agency, Community Number - 060208.
- FERC (1998), Order Approving Settlement Agreement and Amending License. East Bay Municipal Utility District Lower Mokelumne River Hydroelectric Project No. 2916.
- Ferguson RI & Ashworth PJ (1992), Spatial patterns of bedload transport and channel change in braided and near-braided rivers, in: *Dynamics of Gravel-bed Rivers*, Wiley, Chichester (Edited by Billi P, Hey RD, Thorne CR & Tacconi P), Wiley, Chichester, U.K., pp. 477–496.
- Ferguson RI & Werritty A (1983), Bar development and channel changes in the gravelly River Feshie, Scotland, *International Association of Sedimentologists Special Publications*, **6**: 181–193.
- Fisher P, Wood J & Cheng T (2004), Where is Helvellyn? Fuzziness of multi-scale landscape morphometry, *Transactions of the Institute of British Geographers*, **29**: 106–128.
- Fleckenstein JH, Niswonger RG & Fogg GE (2006), River-aquifer interactions, geologic heterogeneity, and low-flow management, *Ground Water*, **44**(6): 837–852.
- Francis RC & Sibley TH (1991), Climate Change and Fisheries - What Are the Real Issues, *Northwest Environmental Journal*, **7**(2): 295–307.
- French J & Clifford N (2000), Hydrodynamic modeling as a basis for explaining estuarine environmental dynamics: some computational and methodological issues, *Hydrological Processes*, **14**: 2089–2108.
- French JR (2003), Airborne LiDAR in support of geomorphological and hydraulic modelling, *Earth Surface Processes and Landforms*, **28**(3): 321–335.
- Friedland KD (1998), Ocean climate influences on critical Atlantic salmon (*Salmo salar*) life history events, *Canadian Journal of Fisheries and Aquatic Sciences*, **55**: 119–130.
- Friedland KD, Reddin DG, McMenemy JR & Drinkwater KF (2003), Multidecadal trends in North American Atlantic salmon (*Salmo salar*) stocks and climate trends relevant to juvenile survival, *Canadian Journal of Fisheries and Aquatic Sciences*, **60**(5): 563–583.
- Fuller IC, Large ARG, Charlton ME, Heritage GL & Milan DJ (2003), Reach-scale sediment transfers: An evaluation of two morphological budgeting approaches, *Earth Surface Processes and Landforms*, **28**(8): 889–903.
- Fuller IC, Passmore DG, Heritage G, Large ARG, Milan DJ & Brewer PA (2002), Annual sediment budgets in an unstable gravel-bed river: the River Coquet, northern England, in: *In Sediment Flux to Basins: Causes, Controls and Consequences, Special Publication 191* (Edited by S J & Frostick L), Geological Society, London, pp. 115–131.
- Gaeuman DA, Schmidt JC & Wilcock PR (2003), Evaluation of in-channel gravel storage with morphology-based gravel budgets developed from planimetric data, *Journal of Geophysical Research- Earth Surface*, **108**: 1–16.
- Gardiner R & Mackay D (2002), Fish and Fisheries, in: *The Ecology, Land Use and conservation of the Cairngorm* (Edited by Gimingham C), Packard, Chichester.
- Garibaldi A & Turner N (2004), Cultural Keystone Species: Implications for Ecological Conservation and Restoration, *Ecology and Society*, **9**(3): 1 [online] url: <http://www.ecologyandsociety.org/vol9/iss3/art1>.
- Geist DR (2000), Hyporheic discharge of river water into fall chinook salmon (*Oncorhynchus tshawytscha*) spawning areas in the Hanford Reach, Columbia River, *Can. J. Fish. Aquat. Sci.*, **57**: 1647–1656.
- Geist DR & Dauble DD (1998), Redd site selection and spawning habitat use by fall chinook salmon: The importance of geomorphic features in large rivers, *Environmental Management*, **22**(5): 655–669.

- Gibbins C, Vericat D, Batalla RJ & Gomez CM (2007), Shaking and moving: low rates of sediment transport trigger mass drift of stream invertebrates, *Canadian Journal of Fisheries and Aquatic Sciences*, **64**(1): 1–5.
- Gibson RJ, Haedrich RL & Wernerheirn CM (2005), Loss of fish habitat as a consequence of inappropriately constructed stream crossings, *Fisheries*, **30**(1): 10–17.
- Gillilan S, Boyd K, Hoitsma T & Kauffman M (2005), Challenges in developing and implementing ecological standards for geomorphic river restoration projects: a practitioner's response to Palmer et al. (2005), *Journal of Applied Ecology*, **42**(2): 223–227.
- Gilvear DJ (1999), Fluvial geomorphology and river engineering: future roles utilizing a fluvial hydrosystems framework, *Geomorphology*, **31**(1–4): 229–245.
- Gilvear DJ, Cecil J & Parsons H (2000), Channel change and vegetation diversity on a low-angle alluvial fan, River Feshie, Scotland, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **10**(1): 53–71.
- Gilvear DJ, Davids C & Tyler AN (2004), The use of remotely sensed data to detect channel hydromorphology; River Tummel, Scotland, *River Research and Applications*, **20**(7): 795–811.
- Gilvear DJ, Heal KV & Stephen A (2002), Hydrology and the ecological quality of Scottish river ecosystems, *The Science of The Total Environment*, **294**(1–3): 131–159.
- Gilvear DJ, Waters TM & Milner AM (1995), Image-Analysis of Aerial-Photography to Quantify Changes in Channel Morphology and Instream Habitat Following Placer Mining in Interior Alaska, *Freshwater Biology*, **34**(2): 389–398.
- Gilvear DJ & Winterbottom SJ (1992), Channel Change and Flood Events since 1783 on the Regulated River Tay, Scotland - Implications for Flood Hazard Management, *Regulated Rivers-Research Management*, **7**(3): 247–260.
- Goff JR & Ashmore P (1994), Gravel Transport and Morphological Change in Braided Sunwapta River, Alberta, Canada, *Earth Surface Processes and Landforms*, **19**(3): 195–212.
- Golet GH, Brown DL, Crone EE, Geupel GR, Greco SE, Holl KD, Jukkola DE, Kondolf GM, Larsen EW & Ligon FK (2003), Using science to evaluate restoration efforts and ecosystem health on the Sacramento River Project, California, in: *California riparian systems: processes and floodplain management, ecology, and restoration. 2001 Riparian Habitat and Floodplains Conference Proceedings, Riparian Habitat Joint Venture, Sacramento, California* (Edited by Faber P), Sacramento, CA, p. 368385.
- Golledge N (2004), The geomorphology and Quaternary geology of the upper Feshie and northern Gaick, in: *The Quaternary of the Central Grampian Highlands* (Edited by Lukas S, Merritt J & Mitchel W), Quaternary Research Association, London, pp. 144–148.
- Gottesfeld A, Hassan M, Tunnicliffe J & Poirer R (2004), Sediment dispersion in salmon spawning streams: The influence of floods and salmon redd construction, *Journal of the American Water Resources Association*, **40**(4): 1071–1086.
- Graf WL (2000), Locational Probability for a Dammed, Urbanizing Stream: Salt River, Arizona, USA, *Environmental Management*, **25**(3): 321–335.
- Graf WL, Diamond M & Kronvang B (2008), Sources of Uncertainty in Scientific Research, in: *River Restoration: Managing the Uncertainty in Restoring Physical Habitat* (Edited by Darby SE & Sear D), John Wiley and Sons, Chichester, U.K.
- Grant J, Soulsby C, Malcolm I & Gibbins C (2007), Do groundwater - surface water exchange patterns in the floodplain channels of a braided river affect spawning site selection by Atlantic salmon?, *Geophysical Research Abstracts*, **9**: 09,496.
- Grant J, Soulsby C & Malcom I (2006), Groundwater influence in hyporheic zones: a key control on site selection for Atlantic salmon spawning in a braided river system?, *Geophysical Research Abstracts*, **8**: 04,304.
- Graymer RW, Jones D & Brabb E (2007), *Geologic map and map database of eastern Sonoma and western Napa Counties, California*, Technical Report Scientific Investigations Map 2956, U.S. Geological Survey, Menlo Park, CA.
- Greig SM, Sear DA & Carling PA (2007), A review of factors influencing the availability of dissolved oxygen to incubating salmonid embryos, *Hydrological Processes*, **21**(3): 323–334.

- Grossinger R, Striplen C, Brewster E & McKee L (2003), *Ecological, Geomorphic, and Land Use History of Sulphur Creek Watershed: A component of the watershed management plan for the Sulphur Creek watershed, Napa County, California. A Technical Report of the Regional Watershed Program*, Technical Report SFEI Contribution 69, San Francisco Estuary Institute, Oakland, CA.
- Hall CT (2006), Wild weather rood in on jet stream: Meteorologists say easterly winds carried moisture all the way from the Philippines.
- Hankin BG, Hardy R, Kettle H & Beven KJ (2001), Using CFD in a GLUE framework to model the flow and dispersion characteristics of a natural fluvial dead zone, *Earth Surface Processes and Landforms*, **26**(6): 667–687.
- Hansen LR & Quinn TR (1998), The marine phase of the Atlantic salmon (*Salmo salar*) life cycle, with comparisons to Pacific salmon, *Canadian Journal of Fisheries and Aquatic Sciences*, **55**: 104–118.
- Hassan M, Gottesfeld A & Tunnicliffe J (2002), Sediment mobility in fish bearing streams: the influence of floods and spawning salmon, *Eos Trans. AGU Fall Meeting Supplement*, **83**(47): Abstract H21C–0831.
- Helton JC (1994), Treatment of Uncertainty in Performance Assessments for Complex Systems, *Risk Analysis*, **14**(4): 483–511.
- Hendry K, Cragg-Hine D, Grady M, Sambrook H & Stephen A (2003), Management of habitat for rehabilitation and enhancement of salmonid stocks, *Fisheries Research*, **62**(2003): 171–192.
- Henrion M & Fischhoff B (1986), Assessing Uncertainty in Physical Constants, *Annual Journal of Physics*, **54**(9): 791–797.
- Henson SS, Ahearn DS, Dahlgren RA, Van Nieuwenhuysse E, Tate KW & Fleenor WE (2007), Water quality response to a pulsed-flow event on the Mokelumne River, California, *River Research and Applications*, **23**(2): 185–200.
- Heritage G & Hetherington D (2007), Towards a protocol for laser scanning in fluvial geomorphology, *Earth Surface Processes and Landforms*, **32**(1): 66–74.
- Heritage GL, Fuller IC, Charlton ME, Brewer PA & Passmore DP (1998), CDW photogrammetry of low relief fluvial features: Accuracy and implications for reach-scale sediment budgeting, *Earth Surface Processes and Landforms*, **23**(13): 1219–1233.
- Herschy RW (2002), The uncertainty in a current meter measurement, *Flow Measurement and Instrumentation*, **13**: 281–284.
- Hilderbrand GV, Farley SD, Schwartz CC & Robbins CT (2004), Importance of salmon to wildlife: Implications for integrated management, *Ursus*, **15**(1): 1–9.
- Holling C (1978), *Adaptive Environmental Assessment and Management*, Wiley, Chichester, U.K., 377 pp.
- Horssen Pv, Pebesma E & Schot P (2002), Uncertainties in spatially aggregated predictions from a logistic regression model, *Ecological Modelling*, **154**: 93–101.
- Hubbard A, Willis I, Sharp M, Mair D, Nienow P, Hubbard B & Blatter H (2000), Glacier mass-balance determination by remote sensing and high-resolution modelling, *Journal of Glaciology*, **46**(154): 491–498.
- Hughes FMR, Colston A & Mountford JO (2005), Restoring riparian ecosystems: The challenge of accommodating variability and designing restoration trajectories, *Ecology and Society*, **10**(1): 12. [online] URL: <http://www.ecologyandsociety.org/vol10/iss1/art12/>.
- IPCC (2007), *Climate Change 2007: The Physical Science Basis - Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 996 pp.
- ISO (1995), *Guide to the expression of uncertainty in measurement*, Technical report, International Standards Organization, Geneva, Austria.
- Jamieson D (1996), Scientific Uncertainty: how do we know when to communicate research findings to the public?, *The Science of the Total Environment*, **184**: 103–107.
- Jang JR & Gulley N (2007), *Fuzzy Logic Toolbox 2: User Guide, Matlab*, Technical report, Matlab, Natick, MA.

- Janssen MA, Anderies JM & Ostrom E (2007), Robustness of social-ecological systems to spatial and temporal variability, *Society Natural Resources*, **20**(4): 307–322.
- Jeffres CA, Klimley AP, Merz JE & Cech JJ (2006), Movement of Sacramento sucker, *Catostomus occidentalis*, and hitch, *Lavinia exilicauda*, during a spring release of water from Camanche Dam in the Mokelumne River, California, *Environmental Biology of Fishes*, **75**(4): 365–373.
- Johnson PA & Brown ER (2001), Incorporating Uncertainty in the Design of Stream Channel Modifications, *Journal of the American Water Resources Association*, **37**(5): 1225–1236.
- Johnson PA & Heil TM (1996), Uncertainty in Estimating Bankfull Conditions, *Water Resources Bulletin*, **32**(6): 1283–1291.
- Jonsson NJLPHB (1991), Variation in Age, Size and Repeat Spawning of Adult Atlantic Salmon in Relation to River Discharge, *The Journal of Animal Ecology*, **60**(3): 937–947.
- Jorde K & Schneider M (2004), *Lecture Notes CE 504: Aquatic Habitat Modeling*, Technical report, University of Idaho, Boise: Ecohydraulics Research Group, Boise, ID.
- Jungwirth M, Moog O & Muhar S (1993), Effects of River Bed Restructuring on Fish and Benthos of a Fifth Order Stream, Melk, Austria, *Regulated Rivers: Research and Management*, **8**: 195–204.
- Kahneman D & Tversky A (1982), *Variants of Uncertainty*, Uncertainty, Cambridge University Press, Cambridge, UK.
- Katzel M & Larsen EW (1999), *Sulphur Creek Watershed Assessment*, Technical report, Prepared for the Mennen Environmental Foundation, San Francisco, CA.
- Kavvas ML (1999), On the coarse-graining of hydrologic processes with increasing scales, *Journal of Hydrology*, **217**(3-4): 191–202.
- Kavvas ML (2003), Nonlinear hydrologic processes: Conservation equations for determining their means and probability distributions, *Journal of Hydrologic Engineering*, **8**(2): 44–53.
- Kemp JL, Harper DM & Crosa GA (2000), The habitat-scale ecohydraulics of rivers, *Ecological Engineering*, **16**(1): 17–29.
- Kerle F, Zollner F, Schneider M, Bohmer J, Kappus B & Baptist MJ (2002), Modelling of long-term fish habitat changes in restored secondary floodplain channels of the River Rhine, in: *Conference Proceedings of the Fourth EcoHydraulics Symposium*, IAHS, Cape Town, South Africa.
- Keutterling A & Thomas A (2006), Monitoring glacier elevation and volume changes with digital photogrammetry and GIS at Gepatschferner glacier, Austria, *International Journal of Remote Sensing*, **27**(19): 4371–4380.
- Kirkby MJ (1996), A Role for Theoretical Models in Geomorphology?, in: *The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology* (Edited by Rhoads BL & Thorn CE), John Wiley and Sons, Chichester, U.K., pp. 257–272.
- Klir G & Yuan B (1995), *Fuzzy Sets and Fuzzy Logic: Theory and Applications*, Prentice Hall, Upper Saddle River, New Jersey, 574 pp.
- Knight F (1921), *Risk, Uncertainty and Profit*, Houghton Mifflin, New York.
- Knighton D (1998), *Fluvial forms and processes : a new perspective*, Arnold, London ; New York, rev. and update edition.
- Koehler J (2003a), *Fish Habitat Assessment: A Component of the Watershed Management Plan for the Sulphur Creek Watershed, Napa County, California*, Technical Report CALFED contract no. 4600001703, Napa County Resource Conservation District, Napa, CA.
- Koehler J (2003b), *Water Quality Study: A Component of the Watershed Management Plan for the Sulphur Creek Watershed, Napa County, California*, Technical Report CALFED contract no. 4600001703, Napa County Resource Conservation District, Napa, CA.
- Koehler J (2005), *Napa River Fisheries Study: The Rutherford Dust Society Restoratoin Reach, Napa County, California*, Technical report, Napa County Resource Conservation District, Napa, CA.

- Kondolf GM (1995), Geomorphological Stream Channel Classification in Aquatic Habitat Restoration - Uses and Limitations, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **5**(2): 127–141.
- Kondolf GM (1997), Hungry water: Effects of dams and gravel mining on river channels, *Environmental Management*, **21**(4): 533–551.
- Kondolf GM (2000), Some suggested guidelines for geomorphic aspects of anadromous salmonid habitat restoration proposals, *Restoration Ecology*, **8**(1): 48–56.
- Kondolf GM & Larson M (1995), Historical Channel Analysis and Its Application to Riparian and Aquatic Habitat Restoration, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **5**(2): 109–126.
- Kondolf GM, Smeltzer M & Kimball L (2001), *Freshwater Gravel Mining and Dredging Issues*, White paper, Center for Environmental Design and Research Washington Department of Fish and Wildlife Washington Department of Ecology Washington Department of Transportation, Berkeley, CA.
- Kondolf GM, Vick JC & Ramirez TM (1996), Salmon spawning habitat rehabilitation on the Merced River, California: An evaluation of project planning and performance, *Transactions of the American Fisheries Society*, **125**(6): 899–912.
- Koopmans TC (1957), *Three Essays on the State of Economic Science*, McGraw Hill Book Company, New York, 231 pp.
- Lackey RT (1997), Restoration of Pacific salmon : the role of science and scientists, in: *Proceedings of the Sixth Biennial Watershed Management Conference* (Edited by Sommarstorm S), Davis, CA, volume Water Resources Center Report No. 92, pp. 35–40.
- Lackey RT (2001), Values, policy, and ecosystem health, *Bioscience*, **51**(6): 437–443.
- Lackey RT (2003a), Pacific northwest salmon: Forecasting their status in 2100, *Reviews in Fisheries Science*, **11**(1): 35–88.
- Lackey RT (2003b), A salmon-centric view of the 21st century in the western United States, *Renewable Resources Journal*, **21**(3): 11–15.
- Lane SN (2005), Roughness - time for a re-evaluation?, *Earth Surface Processes and Landforms*, **30**: 251–253.
- Lane SN & Chandler JH (2003), Editorial: The generation of high quality topographic data for hydrology and geomorphology: New data sources, new applications and new problems, *Earth Surface Processes and Landforms*, **28**(3): 229–230.
- Lane SN, Chandler JH & Richards KS (1994), Developments in Monitoring and Modeling Small-Scale River Bed Topography, *Earth Surface Processes and Landforms*, **19**(4): 349–368.
- Lane SN & Richards KS (1997), Linking river channel form and process: Time, space and causality revisited, *Earth Surface Processes and Landforms*, **22**(3): 249–260.
- Lane SN, Richards KS & Chandler JH (1995), Morphological Estimation of the Time-Integrated Bed-Load Transport Rate, *Water Resources Research*, **31**(3): 761–772.
- Lane SN, Westaway RM & Hicks DM (2003), Estimation of erosion and deposition volumes in a large, gravel-bed, braided river using synoptic remote sensing, *Earth Surface Processes and Landforms*, **28**(3): 249–271.
- Lapointe M, Eaton B, Driscoll S & Latulippe C (2000), Modelling the probability of salmonid egg pocket scour due to floods, *Canadian Journal of Fisheries and Aquatic Sciences*, **57**(6): 1120–1130.
- Lawler DM (2005), Defining the moment of erosion: the principle of thermal consonance timing, *Earth Surface Processes and Landforms*, **30**(13): 1597–1615.
- Leclerc M, Boudreault A, Bechara JA & Corfa G (1995), Two-dimensional hydrodynamic modeling: a neglected tool in the instream flow incremental methodology, *Transactions of the American Fisheries Society*, **124**(5): 645–662.
- Lemons J & Victor R (2008), Uncertainty in River Restoration, in: *River Restoration: Managing the Uncertainty in Restoring Physical Habitat* (Edited by Darby SE & Sear D), John Wiley and Sons, Chichester, U.K.
- Lempert RJ, Popper SW & Bankes SC (2003), *Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis*, Technical report, The Rand Pardee Center, Santa Monica, CA.

- Leopold LB (1973), River Channel Change with Time - Example, *Geological Society of America Bulletin*, **84**(6): 1845–1860.
- Leopold LB, Huppman R & Miller A (2005), Direct Observation of Rates of Geomorphic Change: 41 Years of Direct Observation, *American Philosophical Society Proceedings*, **149**(3): 349–371.
- Leopold LB & Maddock T (1953), *The Hydraulic Geometry of Stream Channels and Some Physiographic Implications*, Technical Report Geological Survey Professional Paper 252, United States Geological Survey.
- Leopold LB & Wolman MG (1957), *River channel patterns: braided, meandering, and straight*, Physiographic and hydraulic studies of rivers, U.S. Govt. Print. Off., Washington,.
- Levin SA (1992), The Problem of Pattern and Scale in Ecology, *Ecology*, **73**(6): 1943–1967.
- Levy JK, Hipel KW & Kilgour DM (2000), Using environmental indicators to quantify the robustness of policy alternatives to uncertainty\*1, *Ecological Modelling*, **130**(1-3): 79–86.
- Lewin J (2001), 2. Alluvial Systematics, in: *River Basin Sediment Systems: Archives of Environmental Change* (Edited by Maddy D, Macklin MG & Woodard JC), A.A. Balkema Publishers, Steenwijk, The Netherlands, pp. 19–41, hard Copy in "Stream Ecology/ Geomorphology: Aquatic Habitat Classification Systems" folder.
- Lichti DD, Gordon SJ & Tipdecho T (2005), Error Models and Propagation in Directly Georeferenced Terrestrial Laser Scanner Networks, *Journal of Surveying Engineering-Asce*, **131**(4): 135–142.
- Liedy RA, Becker GS & Harvey BN (2003), *Historical Distribution and Current Status of Steelhead, Coho Salmon and Chinook Salmon in Streams of the San Francisco Estuary, California*, Technical report, Center for Ecosystem Management and Restoration, Oakland, CA.
- Lin JY, Chen YC & Tsao EH (2006), Estimation of ecological high flow, *Hydrological Processes*, **20**(2): 319–328.
- Lindsay JB & Ashmore PE (2002), The effects of survey frequency on estimates of scour and fill in a braided river model, *Earth Surface Processes and Landforms*, **27**(1): 27–43.
- Lisle TE & Lewis J (1992), Effects of Sediment Transport on Survival of Salmonid Embryos in a Natural Stream: A Simulation Approach, *Can. J. Fish. Aquat. Sci*, **49**: 2377–2344.
- Lodwick WA & Santos J (2003), Constructing consistent fuzzy surfaces from fuzzy data, *Fuzzy Sets and Systems*, **135**: 259–277.
- Lorang MS, Whited DC, Hauer FR, Kimball JS & Stanford JA (2005), Using airborne multispectral imagery to evaluate geomorphic work across floodplains of gravel-bed rivers, *Ecological Applications*, **15**(4): 1209–1222.
- Maddock I (1999), The importance of physical habitat assessment for evaluating river health, *Freshwater Biology*, **41**: 373–391.
- Marchi L & Dalla Fontana G (2005), GIS morphometric indicators for the analysis of sediment dynamics in mountain basins, *Environmental Geology*, **48**(2): 218–228.
- Marks K & Bates P (2000), Integration of high-resolution topographic data with floodplain flow models, *Hydrological Processes*, **14**(11-12): 2109–2122.
- Martin Y & Church M (1995), Bed-Material Transport Estimated from Channel Surveys - Vedder River, British-Columbia, *Earth Surface Processes and Landforms*, **20**(4): 347–361.
- Martin Y & Church M (2004), Numerical modelling of landscape evolution: geomorphological perspectives, *Progress in Physical Geography*, **28**(3): 317–339.
- McIntyre N, Wheeler H & Lees M (2002), Estimation and propagation of parametric uncertainty in environmental models, *Journal of Hydroinformatics*, **4**(3): 177–198.
- McLean DG & Church M (1999), Sediment transport along lower Fraser River 2. Estimates based on the long-term gravel budget, *Water Resources Research*, **35**(8): 2549–2559.
- McPhee MV & Quinn TP (1998), Factors affecting the duration of nest defense and reproductive lifespan of female sockeye salmon, *Oncorhynchus nerka*, *Environmental Biology of Fishes*, **51**(4): 369–375.

- Meentemeyer V (1989), Geographical perspectives of space, time and scale, *Landscape Ecology*, **3**(3-4): 163–173.
- Merriam-Webster (1994), *Merriam Webster's Collegiate Dictionary*, Merriam-Webster, Inc., Springfield, Massachusetts, U.S.A., tenth edition edition, 1559 pp.
- Merz JE, Pasternack GB & Wheaton JM (2006), Sediment budget for salmonid spawning habitat rehabilitation in a regulated river, *Geomorphology*, **76**(1-2): 207–228.
- Merz JE & Setka JD (2004), Evaluation of a spawning habitat enhancement site for Chinook salmon in a regulated California River, *North American Journal of Fisheries Management*, **24**(2): 397–407.
- Merz JE, Setka JD, Pasternack GB & Wheaton JM (2004), Predicting benefits of spawning-habitat rehabilitation to salmonid (*Oncorhynchus* spp.) fry production in a regulated California river, *Canadian Journal of Fisheries and Aquatic Sciences*, **61**(8): 1433–1446.
- Mesa MG & Magie CD (2006), Evaluation of energy expenditure in adult spring Chinook salmon migrating upstream in the Columbia River Basin: An assessment based on sequential proximate analysis, *River Research and Applications*, **22**(10): 1085–1095.
- Milan DJ, Heritage GL & Hetherington D (2007), Application of a 3D laser scanner in the assessment of erosion and deposition volumes and channel change in a proglacial river, *Earth Surface Processes and Landforms*, **Early View**: On-Line.
- Milhous RT (1998), Modelling of Instream Flow Needs: The Link Between Sediment and Aquatic Habitat, *Regulated Rivers: Research and Management*, **14**: 79–94.
- Miller J, Frederick R & Tracey H (1973), *NOAA Atlas 2: Precipitation Frequency Atlas of the Western United States*, Technical Report Volume XI - California, National Oceanic and Atmospheric Administration, Silver Spring, MD.
- Milne J & Sear D (1997), Modelling river channel topography using GIS, *International Journal of Geographical Information Science*, **11**(5): 499–519.
- Montgomery DR, Beamer EM, Pess GR & Quinn TP (1999), Channel type and salmonid spawning distribution and abundance, *Canadian Journal of Fisheries and Aquatic Sciences*, **56**: 377–387.
- Montgomery DR & Bolton S (2003), 3. Hydrogeomorphic Variability and River Restoration, in: *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems* (Edited by Wissmar RC, Bisson PA & Duke M), American Fisheries Society, Bethesda, Maryland, 1st edition, pp. 39–80.
- Montgomery DR & Buffington JM (1997), Channel-reach morphology in mountain drainage basins, *Geological Society of America Bulletin*, **109**(5): 596–611.
- Montgomery DR, Buffington JM, Peterson NP, Schuett-Hames D & Quinn TP (1996), Stream-bed scour, egg burial depths, and the influence of salmonid spawning on bed surface mobility and embryo survival, *Canadian Journal of Fisheries and Aquatic Sciences*, **53**(5): 1061–1070.
- Moore JM, Schindler DE & Scheuerell MD (2004), Disturbance of freshwater habitats by anadromous salmon in Alaska, *Oecologia*, **139**: 298–308.
- Mouton AM, Schneider M, Depestele J, Goethals PLM & De Pauw N (2007), Fish habitat modelling as a tool for river management, *Ecological Engineering*, **29**(3): 305–315.
- Natke HG & Ben-Haim Y, eds. (1996), *Uncertainty: A Discussion from Various Points of View*, Akademie Verlag, Berlin, Germany.
- Newson M & Clark MJ (2008), The Sustainable Management of Restored Rivers, in: *River Restoration: Managing the Uncertainty in Restoring Physical Habitat* (Edited by Darby SE & Sear D), John Wiley and Sons, Chichester, U.K.
- Newson MD (2002), Geomorphological concepts and tools for sustainable river ecosystem management, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **12**(4): 365–379.
- Newson MD, Clark MJ, Sear DA & Brookes A (1998), The geomorphological basis for classifying rivers, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **8**(4): 415–430.

- Newson MD & Large ARG (2006), 'Natural' rivers, 'hydromorphological quality' and river restoration: a challenging new agenda for applied fluvial geomorphology, *Earth Surface Processes and Landforms*, **31**(13): 1606–1624.
- Oksanen J & Sarjakoski T (2006), Uncovering the statistical and spatial characteristics of fine topographic DEM error, *International Journal of Geographical Information Science*, **20**(4): 345–369.
- Openshaw S (1996), Fuzzy logic as a new scientific paradigm for doing geography, *Environment and Planning A*, **28**(5): 761–768.
- Ormerod SJ (2003), Current issues with fish and fisheries: editor's overview and introduction, *J Appl Ecology*, **40**(2): 204–213.
- Osidele OO, Zeng W & Beck MB (2003), Coping with uncertainty: A case study in sediment transport and nutrient load analysis, *Journal of Water Resources Planning and Management-Asce*, **129**(4): 345–355.
- Palmer MA & Bernhardt ES (2006), Hydroecology and river restoration: Ripe for research and synthesis, *Water Resources Research*, **42**(3).
- Parker G, Hassan M & Wilcock P (2007), Adjustment of the bed surface size distribution of gravel-bed rivers in response to cycled hydrographs, in: *Gravel-Bed Rivers VI: From Process Understanding to River Restoration* (Edited by Habersack H, Piegay H & Rinaldi M), Elsevier Science, St. Jakob, Austria.
- Parrish DL, Behnke RJ, Gephard SR, McCormick SD & Reeves GH (1998), Why aren't there more Atlantic salmon (*Salmo salar*)?, *Canadian Journal of Fisheries and Aquatic Sciences*, **55**: 281–287.
- Parsons H & Gilvear D (2002), Valley floor landscape change following almost 100 years of flood embankment abandonment on a wandering gravel-bed river, *River Research and Applications*, **18**(5): 461–479.
- Pasternack GB (1999), Does the river run wild? Assessing chaos in hydrological systems, *Advances in Water Resources*, **23**(3): 253–260.
- Pasternack GB, Gilbert AT, Wheaton JM & Buckland EM (2006), Error propagation for velocity and shear stress prediction using 2D models for environmental management, *Journal of Hydrology*, **328**(1-2): 227–241.
- Pasternack GB, Wang CL & Merz JE (2004), Application of a 2D hydrodynamic model to design of reach-scale spawning gravel replenishment on the Mokelumne River, California, *River Research and Applications*, **20**(2): 205–225.
- Payne BA & Lapointe MF (1997), Channel Morphology and lateral stability: effects on distribution of spawning and rearing habitat for Atlantic salmon in a wandering cobble-bed river, *Can. J. Fish. Aquat. Sci.*, **54**: 2627–2636.
- Pearce S, O'Connor M, McKee L & Jones B (2003), *Channel Geomorphology Assessment: A component of the watershed management plan for the Sulphur Creek watershed, Napa County, California. A Technical Report of the Regional Watershed Program*, Technical Report SFEI Contribution 68, San Francisco Estuary Institute, Oakland, CA.
- Petterman RM & Peters CN (1998), Decision Analysis: Taking Uncertainties into Account in Forest Resource Management, in: *Statistical Methods for Adaptive Management Studies* (Edited by Sit V & Taylor B), Research Branch, B.C. Ministry of Forests, Victoria, B.C., volume Land Management Handbook No. 42, pp. 89–104, sEE 6503.
- Petts GE (1996), Water allocation to protect river ecosystems, *Regulated Rivers-Research and Management*, **12**(4-5): 353–365.
- Phillips JD (2001), Contingency and generalization in pedology, as exemplified by texture-contrast soils, *Geoderma*, **102**(3-4): 347–370.
- Pitcher TJ (2001), Fisheries managed to rebuild ecosystems? Reconstructing the past to salvage the future, *Ecological Applications*, **11**(2): 601–617.
- Poff NL, Allan JD, Bain MB, Karr JR, Prestegard KL, Richter BD, Sparks RE & Stromberg JC (1997), The natural flow regime, *Bioscience*, **47**(11): 769–784.
- Pollack HN (2003), *Uncertain Science... Uncertain World*, Cambridge University Press, Cambridge, UK, 243 pp.
- Popper K (1968), *The Logic of Scientific Discovery*, volume Second Edition, Harper and Row, New York, 480 pp.
- Power ME & Dietrich WE (2002), Food webs in river networks, *Ecological Research*, **17**(4): 451–471.

- Price DJS (1965), Is Technology Historically Independent of Science? A Study in Statistical Historiography, *Technology and Culture*, **6**(4): 553–568.
- Priddy R (1999), *Science Limited*, Available on the web: <http://home.no.net/rrpriddy/indexlim.html>, Oslo, Norway.
- PWA (2003), *Final Technical Report Sediment Source Assessment, A Component of the Watershed Management Plan for the Sulphur Creek Watershed, Napa County, California*, Technical Report CALFED contract no. 4600001703, prepared for Stewardship Support and Watershed Assessment in the Napa River Watershed: by Pacific Watershed Associates, Arcata, CA.
- Pyrce RS & Ashmore PE (2003), The relation between particle path length distributions and channel morphology in gravel-bed streams: a synthesis, *Geomorphology*, **56**(1-2): 167–187.
- Pyrce RS & Ashmore PE (2005), Bedload path length and point bar development in gravel-bed river models, *Sedimentology*, **52**(4): 839–857.
- Reckhow K (2003), On the Need for Uncertainty Assessment in TMDL Modeling and Implementation, *Journal of Water Resources Planning and Management-Asce*, **129**(4): 245–246.
- Rhoads BL & Thorn CE (1996a), The Scientific Nature of Geomorphology, in: *Proceedings of the 27th Binghamton Symposium in Geomorphology*, John Wiley and Sons, p. 481.
- Rhoads BL & Thorn CE (1996b), Toward a Philosophy of Geomorphology, in: *The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology* (Edited by Rhoads BL & Thorn CE), John Wiley and Sons, Chichester, U.K., pp. 115–144.
- Richard S Pyrce PEA (2003), Particle path length distributions in meandering gravel-bed streams: results from physical models, *Earth Surface Processes and Landforms*, **28**(9): 951–966.
- Riebeek H (2002), The Perception of Scientific Uncertainty in Science News Writing.
- Rippin D, Willis I, Arnold N, Hodson A, Moore J, Kohler J & Bjornsson H (2003), Changes in geometry and subglacial drainage of Midre Lovénbreen, Svalbard, determined from digital elevation models, *Earth Surface Processes and Landforms*, **28**(3): 273–298.
- Robertson-Rintoul MSE (1986), A quantitative soil-stratigraphic approach to the correlation and dating of post-glacial river terraces in Glen Feshie, western Cairngorms, *Earth Surface Processes and Landforms*, **11**(6): 605–617.
- Rodgers P, Soulsby C, Petry J, Malcolm I, Gibbins C & Dunn S (2004), Groundwater-surface-water interactions in a braided river: a tracer-based assessment, *Hydrological Processes*, **18**(7): 1315–1332.
- Rodgers P, Soulsby C & Waldron S (2005), Stable isotope tracers as diagnostic tools in upscaling flow path understanding and residence time estimates in a mountainous mesoscale catchment, *Hydrological Processes*, **19**(11): 2291–2307.
- Rosgen D (1996), *Applied River Morphology*, Wildland Hydrology, Pagosa Springs, CO.
- Rotmans J & Van Asselt M (2001), Uncertainty Management in Integrated Assessment Modeling: Towards a Pluralistic Approach, *Environmental Monitoring and Assessment*, **69**(2): 101 – 130.
- Routledge RD (1998), Chapter 5: Measurements and Estimates, in: *Statistical Methods for Adaptive Management Studies* (Edited by Sit V & Taylor B), B.C. Ministry of Forests, Victoria, B.C., volume Land Management Handbook No. 42, pp. 55–68.
- Ruckelshaus MH, Levin P, Johnson JB & Kareiva PM (2002), The Pacific salmon wars: What science brings to the challenge of recovering species, *Annual Review of Ecology and Systematics*, **33**: 665–706.
- Rumsby B, McVey R & Brasington J (2001), 16. The Potential for high resolution fluvial archives in braided rivers: quantifying historic reach-scale channel and floodplain development in the River Feshie, Scotland, in: *River Basin Sediment Systems: Archives of Environmental Change* (Edited by Maddy D, Macklin MG & Woodard JC), A.A. Balkema Publishers, Steenwijk, The Netherlands, pp. 445–467, hard Copy in "Geomorphic Processes: DTM Differencing" folder.
- Sabine E, Schreiber G, Bearlin AR, Nicol SJ & Todd CR (2004), Adaptive management: a synthesis of current understanding and effective application, *Ecological Management and Restoration*, **5**(3): 177–182.

- Samuels P, Bramley M & Evans E (2003), *Reducing Uncertainty in Conveyance Estimation*, Technical report, HR Wallingford, Wallingford, UK.
- Sawyer A, Pasternack GB, Merz JE & Senter A (Submitted), Construction constraints for geomorphic-unit rehabilitation on regulated gravel-bed rivers, *River Research and Applications*.
- Schmidt J & Hewitt A (2004), Fuzzy land element classification from DTMs based on geometry and terrain position, *Geoderma*, **121**: 243–256.
- Schneider M & Jorde K (2003), Fuzzy-Rule Based Models for the Evaluation of Fish Habitat Quality and Instream Flow Assessment, in: *Proc. International IFIM Users Workshop*, Fort Collins, CO, p. 22.
- Schulz K & Huwe B (1999), Uncertainty and sensitivity analysis of water transport modelling in a layered soil profile using fuzzy set theory, *Journal of Hydroinformatics*, **1**(2): 127–138.
- Schumm S (1977), *The Fluvial System*, Wiley, New York.
- Schumm S & Lichty R (1965), Time, Space and Causality in Geomorphology, *American Journal of Science*, **263**(February): 110–119.
- Schumm SA (1991), *To Interpret the Earth: Ten ways to be wrong*, Cambridge University Press, Cambridge, UK, 132 pp.
- SCS (1967), *Report and general soil map, San Joaquin County, California*, Technical report, USDA Soil Conservation Service.
- Sear D (2004), Event bedload yield measured with load cell bedload traps and prediction of bedload yield from hydrograph shape, in: *Erosion and sediment transport measurement in rivers: technological methodological advances* (Edited by Bogen J & Walling D), IAHS, Wallingford, UK, pp. 146 – 153.
- Sear D, Wheaton J & Darby SE (2008), Uncertain restoration of gravel-bed rivers and the role of geomorphology, in: *Gravel-Bed Rivers VI: From Process Understanding to River Restoration* (Edited by Habersack H, Piegay H & Rinaldi M), Elsevier, pp. 739–760.
- Sear DA (1994), River Restoration and Geomorphology, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **4**(2): 169–177.
- Sear DA & Milne JA (2000), Surface modelling of upland river channel topography and sedimentology using GIS, *Physics and Chemistry of the Earth Part B-Hydrology Oceans and Atmosphere*, **25**(4): 399–406.
- Sear DA & Newson MD (2003), Environmental change in river channels: a neglected element. Towards geomorphological typologies, standards and monitoring, *The Science of the Total Environment*, **310**: 17–23.
- SEPA (2003), *River Spey Catchment Management Plan*, Technical report, Scottish Environmental Protection Agency, Aviemore.
- SFBWQB (2002), *Napa River Basin Limiting Factors Analysis*, Technical report, Prepared for the San Francisco Bay Water Quality Control Board by Stillwater Sciences, Berkeley, CA.
- Sheer MB & Steel EA (2006), Lost watersheds: Barriers, aquatic habitat connectivity, and salmon persistence in the Willamette and Lower Columbia River basins, *Transactions of the American Fisheries Society*, **135**(6): 1654–1669.
- Sherman DJ (1996), Fashion in Geomorphology, in: *The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology* (Edited by Rhoads BL & Thorn CE), John Wiley and Sons, Chichester, U.K., pp. 57–86.
- Shields FD, Copeland RR, Klingeman PC, Doyle MW & Simon A (2003), Design for stream restoration, *Journal of Hydraulic Engineering-Asce*, **129**(8): 575–584.
- Singh VP & Woolhiser DA (2002), Mathematical modeling of watershed hydrology, *Journal of Hydrologic Engineering*, **7**(4): 270–292.
- Sit V & Taylor B, eds. (1998), *Statistical Methods for Adaptive Management Studies*, volume Land Management Handbook No. 42, Research Branch, B.C. Ministry of Forests, Victoria, B.C.

- Smith J (2001), *Mokelumne River Spawning Habitat Improvement Project - Draft Report*, Technical report, East Bay Municipal Utility District, Lodi, CA.
- Smith LC, Alsdorf DE, Magilligan FJ, Gomez B, Mertes LAK, Smith ND & Garvin JB (2000), Estimation of erosion, deposition, and net volumetric change caused by the 1996 Skeioararsandur jokulhlaup, Iceland, from synthetic aperture radar interferometry, *Water Resources Research*, **36**(6): 1583–1594.
- Sommer T, Nobriga M, Harrel W, Batham W & Kimmerer W (2001), Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival, *Can. J. Fish. Aquat. Sci.*, **58**: 325–333.
- Sommer TR, Harrell WC & Nobriga ML (2005), Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain, *North American Journal of Fisheries Management*, **25**(4): 1493–1504.
- Soulsby C, Malcolm IA, Youngson AF, Tetzlaff D, Gibbins CN & Hannah DM (2005), Groundwater-surface water interactions in upland Scottish rivers: hydrological, hydrochemical and ecological implications, *Scottish Journal of Geology*, **41**: 39–49.
- Soulsby C, Malcolm R, Gibbins C & Dilks C (2001), Seasonality, water quality trends and biological responses in four streams in the Cairngorm Mountains, Scotland, *Hydrology and Earth System Sciences*, **5**(3): 433–450.
- Soulsby C, Tetzlaff D, Rodgers P, Dunn S & Waldron S (2006), Runoff processes, stream water residence times and controlling landscape characteristics in a mesoscale catchment: An initial evaluation, *Journal of Hydrology*, **325**(1–4): 197–221.
- Spedding N (1997), On Growth and Form in Geomorphology, *Earth Surface Processes and Landforms*, **22**: 261–265.
- Stanford JA, Lorang MS & Hauer FR (2005), The shifting habitat mosaic of river ecosystems, in: *Verh. Internat. Verein. Limnol.*, Stuttgart, Germany.
- Stanford JA, Ward J, Liss WJ, Frissell CA, Williams RN, Lichatowich JA & Coutant CC (1996), A General Protocol for Restoration of Regulated Rivers, *Regulated Rivers: Research and Management*, **12**: 391–413.
- Stewardson M & Rutherford I (2008), Conceptual and mathematical modelling in river restoration: Do we have unreasonable confidence?, in: *River Restoration: Managing the Uncertainty in Restoring Physical Habitat* (Edited by Darby SE & Sear D), John Wiley and Sons, Chichester, U.K.
- Stuart H (2007), Just say NO to equifinality, *Hydrological Processes*, **21**(14): 1979–1980.
- Sullivan SMP, Watzin MC & Hession WC (2006), Influence of stream geomorphic condition on fish communities in Vermont, USA, *Freshwater Biology*, **51**(10): 1811–1826.
- Swansburg E, Chaput G, Moore D, Caissie D & El-Jabi N (2002), Size variability of juvenile Atlantic salmon: links to environmental conditions, *Journal of Fish Biology*, **61**: 661–683.
- Taylor BN & Kuyatt CE (1994), *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, Technical Report NIST Technical Note 1297, United States Department of Commerce: National Institute of Standards and Technology, Washington D.C.
- Taylor J (1997), *An Introduction to Error Analysis: the Study of Uncertainties in Physical Measurements*, volume Second Edition, University Science Books, Sausalito, California, second edition edition, 327 pp.
- Taylor MP, Macklin MG & Hudson-Edwards K (2000), River sedimentation and fluvial response to Holocene environmental change in the Yorkshire Ouse Basin, northern England, *Holocene*, **10**(2): 201–212.
- Teng M & Belfrage K (2004), Local Management Practices for Dealing with Change and Uncertainty: A Cross-scale Comparison of Cases in Sweden and Tanzania, *Ecology and Society*, **9**(3): 4: [Online] url: <http://www.ecologyandsociety.org/vol9/iss3/art4>.
- Thomas R (2006), *'Flow Processes and Channel Change in Sand-Bedded Braided Rivers'* Ph.D Thesis, University of Leeds, Ph.d. thesis, University of Leeds, Leeds, UK.
- Thomson JR, Taylor MP & Brierley G (2003), Are River Styles ecologically meaningful? A test of the ecological significance of a geomorphic river characterization scheme, *Aquatic Conservation-Marine and Freshwater Ecosystems*.

- Thomson JR, Taylor MP, Fryirs KA & Brierley GJ (2001), A geomorphological framework for river characterization and habitat assessment, *Aquatic Conservation-Marine and Freshwater Ecosystems*, **11**(5): 373–389.
- Tockner K, Paetzold A, Karaus U, Claret C & Zettel J (2006), Ecology of Braided Rivers, in: *Braided Rivers* (Edited by Sambrook-Smith GH, Best JL, Bristow CS & Petts G), Blackwell Publishers, Oxford, pp. 339–360.
- Trochim WM (2000), *The Research Methods Knowledge Base, 2nd Edition*, Atomic Dog Publishing, Cincinnati, OH., Internet WWW page, at URL: <http://www.socialresearchmethods.net/kb/> (version current as of August 16, 2004) pp.
- Valle BL & Pasternack GB (2005), Field mapping and digital elevation models of two hydraulic jump regions in a step-pool mountain channel, *Earth Surface Processes and Landforms*, **31**(6): 646–664.
- Van Asselt M (2000), *Perspectives on uncertainty and risk: The PRIMA approach to decision support*, Ph.d. thesis, Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Van Asselt MBA & Rotmans J (2002), Uncertainty in integrated assessment modelling - From positivism to pluralism, *Climatic Change*, **54**(1-2): 75–105.
- Van der Lee GEM, Van der Molen DT, Van den Boogaard HFP & Van der Klis H (2006), Uncertainty analysis of a spatial habitat suitability model and implications for ecological management of water bodies, *Landscape Ecology*, **21**(7): 1019–1032.
- van Witteloostuijn A (1987), *Uncertainty in Psychology: A Look beyond the Non-Differentiated Approach*, Ph.D. thesis, Maastricht University, Maastricht.
- Varis O (1997), Bayesian decision analysis for environmental and resource management, *Environmental Modeling and Software*, **12**(2-3): 177–185.
- Vaux WG (1962), *Interchange of Stream and Intergravel Water in a Salmon Spawning Riffle*, Technical Report Contribution No. 82, United States Fish and Wildlife Service, Washington D.C.
- Vericat D, Brasington J, Wheaton JM & Hodge R (2007), Reach-Scale Retrieval of Alluvial Bed Roughness, *Eos Trans. AGU*, **88**(52): Fall Meet. Suppl., Abstract H51E-0799.
- Villard PV & Church M (2005), Bar and dune development during a freshet: Fraser River Estuary, British Columbia, Canada, *Sedimentology*, **52**(4): 737–756.
- Vincent K (2007), Uncertainty in adaptive capacity and the importance of scale, *Global Environmental Change-Human and Policy Dimensions*, **17**(1): 12–24.
- von Schomberg R, ed. (1993), *Controversies and Political Decision Making*, Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Walters C (1997), Challenges in adaptive management of riparian and coastal ecosystems, *Conservation Ecology [online]*, **1**(2): 1. Available from the Internet. URL: <http://www.consecol.org/vol1/iss2/art1>.
- Wang C & Pasternack G (2001), *Application of a 2D Hydraulic Model to Reach-scale Spawning Gravel Rehabilitation - Draft Final Report*, Technical report, University of California at Davis: LAWR Department, Davis, CA.
- Ward JV, Tockner K, Arscott DB & Claret C (2002), Riverine landscape diversity, *Freshwater Biology*, **47**(4): 517–539.
- Ward T (1998), Chapter 6: Risk and Uncertainty in Environmental Policy Evaluation, in: *Global Environmental Economics: Equity and the Limits of Markets* (Edited by Dore MHI & Mount TD), Blackwell Publishers, UK, pp. 116–135.
- Webb RM & Haupt TC (2003), The potential of 4D CAD as a tool for construction management, in: *4D CAD and Visualization in Construction: Developments and Applications* (Edited by Issa RR, Flood I & O'Brien WJ), Taylor Francis, pp. 227–243.
- Wechsler SP & Kroll CN (2006), Quantifying DEM uncertainty and its effect on topographic parameters, *Photogrammetric Engineering and Remote Sensing*, **72**(9): 1081–1090.
- Werritty A (1984), Stream Response to Flash Floods in Upland Scotland, in: *Catchment Experiments in Fluvial Geomorphology* (Edited by Walling DE & Burt T), Geo-Books, Norwich, England, pp. 537–560, referenced in Ferguson and Werritty 1983.

- Werritty A & Brazier V (1991), *The Geomorphology, Conservation and Management of the River Feshie SSSI, Report for the Nature Conservancy Council*, Technical report, Nature Conservancy Council, Peterborough.
- Werritty A & Ferguson RI (1980), Pattern changes in a Scottish braided river over 1, 30 and 200 years, in: *Timescales in Geomorphology* (Edited by Cullingford R, DA D & Lewin J), Wiley, Chichester, pp. 53–68.
- Werritty A & McEwen L (1993), Glen Feshie, in: *The Quaternary of Scotland* (Edited by Gordon J & Sutherland D), Chapman and Hall, London, volume 6, pp. 298–303.
- Werritty A & Ferguson RI (1980), Pattern change in a Scottish braided river over 1, 30 and 200 years, in: *Timescales in Geomorphology* (Edited by Cullingford R, Davidson D & Lewin J), Wiley, Chichester, U.K., p. 5368.
- Westaway RM, Lane SN & Hicks DM (2000), The development of an automated correction procedure for digital photogrammetry for the study of wide, shallow, gravel-bed rivers, *Earth Surface Processes and Landforms*, **25**(2): 209–226.
- Westaway RM, Lane SN & Hicks DM (2001), Remote sensing of clear-water, shallow, gravel-bed rivers using digital photogrammetry, *Photogrammetric Engineering and Remote Sensing*, **67**(11): 1271–1281.
- Westaway RM, Lane SN & Hicks DM (2003), Remote survey of large-scale braided, gravel-bed rivers using digital photogrammetry and image analysis, *International Journal of Remote Sensing*, **24**(4): 795–815.
- Wheaton J (2005), Salmon! In Sulphur Creek?, *Acorn Soupe Scoop Newsletter*, **1**(Spring): 1, 2 5.
- Wheaton J, Brasington J, Brewer PA, Darby SE, Pasternack GB, Sear D, Vericat D & Williams RD (2007), Improved Fluvial Geomorphic Interpretation from DEM Differencing, *Eos Trans. AGU*, **88**(52): Fall Meet. Suppl., Abstract H43E–1672.
- Wheaton J, Brasington J & Williams RD (2004a), Modelling Fluvial Sediment Budgets Under Uncertainty, *Eos Trans. AGU*, **85**(47): Fall Meeting Supplement, Abstract H53C–1264.
- Wheaton J, Sear D, Darby S & Milne J (2004b), The International River Restoration Survey.
- Wheaton JM (2003), *Spawning Habitat Rehabilitation*, M.s. thesis, University of California at Davis, Davis, CA.
- Wheaton JM, Darby SE & Sear D (2008), The Scope of Uncertainties in River Restoration, in: *River Restoration: Managing the Uncertainty in Restoring Physical Habitat* (Edited by Darby SE & Sear D), John Wiley and Sons, Chichester, U.K., pp. 21–39.
- Wheaton JM, Darby SE, Sear DA & Milne JA (2006), Does scientific conjecture accurately describe restoration practice? - Insight from an international river restoration survey, *Area*, **38**(2): 128–142.
- Wheaton JM, Pasternack GB & Merz JE (2004c), Spawning Habitat Rehabilitation - I. Conceptual Approach and Methods, *International Journal of River Basin Management*, **2**(1): 3–20.
- Wheaton JM, Pasternack GB & Merz JE (2004d), Spawning Habitat Rehabilitation - II. Using Hypothesis Testing and Development in Design, Mokelumne River, California, U.S.A., *International Journal of River Basin Management*, **2**(1): 21–37.
- Wheaton JM, Pasternack GB & Merz JE (2004e), Use of habitat heterogeneity in salmonid spawning habitat rehabilitation design, in: *Fifth International Symposium on Ecohydraulics: Aquatic Habitats: Analysis and Restoration* (Edited by Garcia D & Martinez PV), IAHR-AIRH, Madrid, Spain, volume 2, pp. 791–796.
- Whited DC, Lorang MS, Harner MJ, Hauer FR, Kimball JS & Stanford JA (2007), Climate, hydrologic disturbance, and succession: Drivers of floodplain pattern, *Ecology*, **88**(4): 940–953.
- Wiens JA (2002), Riverine landscapes: taking landscape ecology into the water, *Freshwater Biology*, **47**(4): 501–515.
- Wilcock PR (2001), Toward a Practical Method for Estimating Sediment-Transport Rates in Gravel-Bed Rivers, *Earth Surface Processes and Landforms*, **26**: 1395–1408.
- Williams JE, Johnson JE, Hendrickson DA, Contreras-Balderas S, Williams JD, Navarro-Mendoza M, McAllister DE & Deacon JE (1989), Fishes of North America Endangered, Threatened, or of Special Concern: 1989, *Fisheries*, **14**(6): 2–20.

- Williams RD (2004), *Modelling Flow and Channel Change through a Braided Reach of the River Feshie, Scotland*, Undergraduate dissertation, University of Cambridge, Cambridge, UK.
- Willson MF & Halupka KC (1995), Anadromous Fish as Keystone Species in Vertebrate Communities, *Conservation Biology*, **9**(3): 489–497.
- Wilson DW (2001), *On the Problem of Indeterminacy in Fluvial Geomorphology*, Ph.d. thesis, University of Southampton, Southampton, U.K.
- Wilson JP & Burrough PA (1999), Dynamic Modeling, Geostatistics, and Fuzzy Classification: New Sneakers for a New Geography?, *Annals of the Association of American Geographers*, **89**(4): 736–746.
- Winterbottom SJ & Gilvear DJ (1997), Quantification of channel bed morphology in gravel-bed rivers using airborne multispectral imagery and aerial photography, *Regulated Rivers-Research Management*, **13**(6): 489–499.
- Wissmar RC & Bisson PA (2003a), 1. Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty, in: *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems* (Edited by Wissmar RC, Bisson PA & Duke M), American Fisheries Society, Bethesda, Maryland, 1st edition, pp. 3–7.
- Wissmar RC & Bisson PA, eds. (2003b), *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems*, American Fisheries Society, Bethesda, Maryland, 1st edition.
- WMC & UNEP (2005), *Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties*, Technical report, International Panel on Climate Change.
- Wohl E, Angermeier PL, Bledsoe B, Kondolf GM, MacDonnell L, Merritt DM, Palmer MA, Poff NL & Tarboton D (2005), River restoration, *Water Resources Research*, **41**(10).
- Wohl EE (1998), Uncertainty in flood estimates associated with roughness coefficient, *Journal of Hydraulic Engineering-Asce*, **124**(2): 219–223.
- Wood J (1996), *The Geomorphological Characterisation of Digital Elevation Models*, Phd thesis, University of Leicester, Leicester, UK.
- Wu FC & Tsang YP (2004), Second-order Monte Carlo uncertainty/variability analysis using correlated model parameters: application to salmonid embryo survival risk assessment, *Ecological Modelling*, **177**: 369–414.
- WWF (2001), *The Status of Wild Atlantic Salmon: A River by River Assessment*, Technical report, World Wildlife Fund, Oslo, Norway.
- Yoshiyama RM, Fisher F & Moyle PB (1998), Historical abundance and decline of chinook salmon in the Central Valley region of California, *North American Journal of Fisheries Management*, **18**: 487–521.
- Young J (1976), The terraces of Glen Feshie, Inverness-shire, *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **69**: 501–512.
- Youngson AF & Verspoor E (1998), Interactions between wild and introduced Atlantic salmon (*Salmo salar*), *Canadian Journal of Fisheries and Aquatic Sciences*, **55**: 153–160.
- Zadeh LA (1965), Fuzzy Sets, *Information and Control*, **8**(3): 338–353.
- Zadeh LA (1996), Fuzzy Logic = Computing with Words, *IEEE Transactions on Fuzzy Systems*, **4**(2): 103–111.
- Zak SK & Beven KJ (1999), Equifinality, sensitivity and predictive uncertainty in the estimation of critical loads, *The Science of the Total Environment*, **236**: 191–214.
- Zapert R, Gaertner P & Filar J (1998), Uncertainty propagation within an integrated model of climate change, *Energy Economics*, **20**: 571–598.