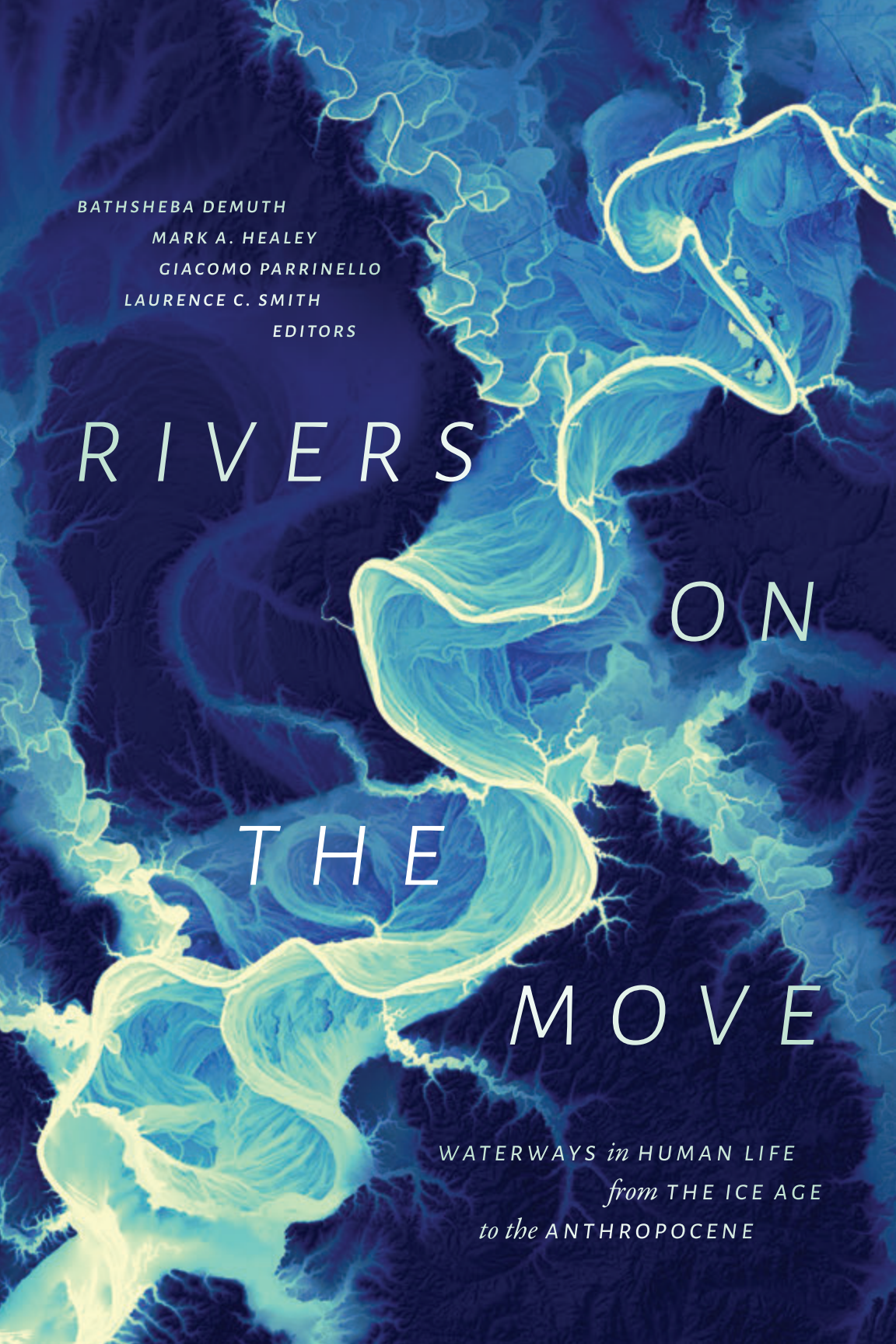

BATHSHEBA DEMUTH
MARK A. HEALEY
GIACOMO PARRINELLO
LAURENCE C. SMITH
EDITORS
RIVERS ON THE MOVE
WATERWAYS in HUMAN LIFE
from THE ICE AGE
to the ANTHROPOCENE

RIVERS ON THE MOVE



BATHSHEBA DEMUTH
MARK A. HEALEY
GIACOMO PARRINELLO
LAURENCE C. SMITH
EDITORS

RIVERS ON THE MOVE

WATERWAYS *in* HUMAN LIFE *from* THE ICE AGE *to the* ANTHROPOCENE

Duke University Press *Durham and London* 2027

DUKE UNIVERSITY PRESS

© 2027 Duke University Press

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, available at https://creativecommons.org/licenses/by-nc-nd/4.0/.
Printed in the United States of America on acid-free paper ∞
Project Editor: Lisa Lawley
Designed by Courtney Leigh Richardson
Typeset in Warnock Pro by Westchester Publishing Services

Library of Congress Cataloging-in-Publication Data
Names: Demuth, Bathsheba editor | Parrinello, Giacomo editor | Healey, Mark editor | Smith, Laurence C. editor
Title: Rivers on the move : waterways in human life from the Ice age to the Anthropocene / Bathsheba Demuth, Mark A. Healey, Giacomo Parrinello, and Laurence C. Smith, editors.
Description: Durham : Duke University Press, 2027. | Includes bibliographical references and index.
Identifiers: LCCN 2026014962 (print)
LCCN 2026014963 (ebook)
ISBN 9781478039600 paperback
ISBN 9781478034568 hardcover
ISBN 9781478063155 ebook
ISBN 9781478094722 ebook other
Subjects: LCSH: Rivers—History | Rivers—Environmental aspects | Rivers—Social aspects | Human ecology | Human geography | Hydrology—Political aspects | Hydrology—Social aspects | Climatic changes | Fluvial geomorphology
Classification: LCC GF63 .R59 2027 (print) | LCC GF63 (ebook) | DDC 551.48/3—dc23/eng/20260729
LC record available at https://lccn.loc.gov/2026014962
LC ebook record available at https://lccn.loc.gov/2026014963

Cover art: River meander image © Daniel Coe, Meander & Flow Design.

The open access publication of this book has been aided by funds from the Institute at Brown for Environment and Society Catalyst Grant and the City of Paris Emergences Programme.

DUKE UNIVERSITY PRESS

publication supported by a grant from

The Community Foundation for Greater New Haven

as part of the

URBAN HAVEN PROJECT

DUKE
UNIVERSITY
PRESS

CONTENTS

Introduction. Rivers on the Move 1
BATHSHEBA DEMUTH AND GIACOMO PARRINELLO

PART I. RESTLESS PASTS

1. Ripples of the Missoula Megafloods 21
SUMMER PRAETORIUS

2. Six Centuries of Polders: Transforming the Jianghan Plain in China 41
HONG JIANG AND IAN RUTHERFURD

3. Tracing the Urubamba: An Archaeohistory of an Andean River 71
R. ALEXANDER HUNTER

4. The Lower Mississippi River and the Novelty of Its Future Geology 89
CATHERINE RUSSELL

PART II. FIXING RIVERS

5. Fixing the Rio Grande at the US-Mexico Border 109
SARAH SEARS

6. Salmon, Imperial Formation, and the Creation of the Yukon River Border Zone, ca. 1900–1930 127
ANDREAS MENTRUP-WOMELSDORF

7. The Politics of Sediment in the Nile's Aswan High Dam 151
GIACOMO PARRINELLO AND SANTIAGO GOROSTIZA

DUKE UNIVERSITY PRESS

PART III. BEYOND WATER

8. The Flying Rivers of Brazil 171
DOUGLAS MCRAE

9. Colombia's Magdalena and the River as Labor 189
VALERIA MANTILLA MORALES

10. Rivers Without Water and the Colonization of Southern Africa 207
ANJULI WEBSTER

PART IV. UNFIXING RIVERS

11. The Dammed Landscapes of Wild Rice Country on the Upper Mississippi 225
ELAINE STOKES

12. The Island That Isn't an Island 245
J. MARTY HOLTGREN AND CAROLINE GOTTSCHALK

13. River Restoration in Times of Climate Change 263
FRANCIS J. MAGILLIGAN

Conclusion. Reimagining Rivers 277
MARK A. HEALEY AND LAURENCE C. SMITH

Acknowledgments 281
Contributors 283
Index 287

DUKE
UNIVERSITY
PRESS

INTRODUCTION

Rivers on the Move

BATHSHEBA DEMUTH AND GIACOMO PARRINELLO

Summers on our warming planet bring near-constant news of rivers: the day nearly a foot of rain fell on Kentucky, pushing rivers beyond their banks; waters lapping at the Taj Mahal; flash inundations in Pennsylvania, New York, Vermont, and Nova Scotia; lethal floods following torrential rain in South Korea; tens of thousands of people displaced as walls of brownish water escaped riverbanks in cities across China; Greek rivers flooded until they looked sealike from the air. Nearly two-thirds of the world's people live along large rivers, and three-quarters of the world's "coastal" population live on river deltas, at risk from waters made increasingly unruly by climate change. Nor is the potential for rivers to disrupt and destroy limited to those living in floodplains. Recent historic droughts of the Po, Rhine, Yangtze, and Colorado basins have affected everything from tourism to shipping to irrigation. The world over, rivers are on the move—and are moving in ways that often spell disaster for human communities.

Yet rivers have always moved—shrinking, growing, changing their habits. Rivers are the result of Earth's water cycle, made as snow and rain fall to the

DUKE UNIVERSITY PRESS

ground and are drawn by gravity back to the oceans with a power that cuts rock, moves soil, builds deltas, and reworks floodplains. Rivers wear down mountains and push new land into oceans. They deliver sediment and nutrients to communities of microbes, insects, plants, fish, and animals. Their rhythm follows the seasons, freezing and thawing, advancing and retreating across flatlands, sometimes drying up entirely only to roar back into their empty beds after rainfall. And by slow erosion or geological cataclysm, they change their courses. Movement is how rivers create landscapes and sustain life. To be a river is to move.

Why, then, does riverine movement spell disaster for many societies today? The human attempt—hardly universal but appearing in many cultures and time periods—to deny, suppress, or harness river movements is, in an era of climate instability, increasingly hard to maintain. *Rivers on the Move* aims to shed light on the tension between rivers' need for movement, and economic, social, and political desires for rivers' stability, exploring how rivers move, what counts as movement, how human societies tried to fix and harness those movements, and how we can imagine new ways of living with rivers on the move.

To do so, this collection investigates river movements and human responses through a plurality of disciplines. Rivers, after all, do not move according to the academic norms that separate social scientists and their insights into human lives and cultures from the knowledge of material processes and change developed by the natural sciences. Hydrologists and geologists working in the Quaternary period must model and explain rivers that have long been under human influence, shaped by political and economic choices that redirect water flows, alter sedimentation, and change the presence (or absence) of trees, plants, and animals.[1] Archaeologists, historians, and other social scientists must embrace the insights of hydrologists, geomorphologists, and river ecologists to accurately bring riverine dynamics into their understanding of human societies.[2] Thus, as scholars like Ellen Wohl, G. Mathias Kondolf, Verena Winiwarter, or Ruth Mostern model in their scholarship, transcending the divide between social and natural sciences is indispensable to understanding riverine transformations.[3]

Rooted in this tradition of interdisciplinary river studies, the editors of *Rivers on the Move* selected essays that, while grounded in a home field, also reached beyond the old binaries separating the human and the natural. Prioritizing such methods led to more diversity of disciplines—the scholars range from fluvial geomorphologists and archaeologists to historians and geologists—than in geography and required that contributors write for

DUKE UNIVERSITY PRESS

readers beyond their academic specialty. The result is a collection meant for a wide range of river-oriented scholars and students.

The volume's chapters are divided into four sections, each addressing one of the book's key themes: the deep history of river movement and social responses to it; the modern drive to fix rivers in space for human use; ways of thinking about rivers beyond water; and present-day attempts to unfix rivers. The introduction follows this structure while highlighting the volume's three central contributions to our understanding of rivers.[4] First, *Rivers on the Move* embraces an expansive timeframe from which to look at rivers' physical movements, from the scale of years, decades, or centuries to millennia and geological epochs. Second, this book highlights a wide range of human interactions with moving rivers, looking at attempts to fix rivers long before the modern era and considering alternative ways to live with rivers' dynamism in the past and present. Finally, the collection expands the understanding of what a river *is*, to include not just water but elements such as vapor, sediment, fish, plants, and human labor.

Thus, at its core, *Rivers on the Move* offers an argument for expanding how we think about both what rivers do and what they are. Doing so sheds light on riverine movements that go beyond the critical importance of water passing between banks to include flying rivers, shifting channels, and geological cataclysms. It also shows why people have fixed rivers, from relatively recent drives to industrialize and make borders to far older agricultural and imperial reasons—interventions that have cast river movement not as necessary, but something to be engineered away, while often intellectually reducing rivers to channels of water. An expansive framing of rivers counters such misunderstandings, bringing to the fore a repertoire of submerged and resurfacing alternatives to fixing rivers that in turn offer insights into how to imagine less catastrophic relationships with moving rivers in the present.

A Restless Past

The movement of rivers has a deep past, one continually reshaped as plate tectonics crash continents and raise mountains, making and remaking the gravitational and erosional pulls that water must follow to the sea (see figure 1.1). The chapters in part I of this volume, drawn from geology, geography/GIS (geographic information systems), and archaeology, join a rich scholarly conversation on the deep-time movements of rivers—a sample of discipline-crossing work on the restlessness of ancient water.

DUKE UNIVERSITY PRESS

By analyzing sediment cores and other nontextual evidence, geologists have reconstructed the transformation of rivers over thousands, even millions, of years to map lost geographies of Earth's water flows.[5] But riverine changes in the deep past have also intersected with the history of human communities. As Summer Praetorius details in "Ripples of the Missoula Megafloods," past climate changes—in this case, the end of the last ice age—transformed hydrology, landscapes, and human lives across hundreds of inland miles, possibly shaping settlement patterns and leaving traces in oral traditions that survive to this day. Ancient storms and rapidly melting ice caused rivers to swell into torrents, sweeping away forests and reshaping the landscape in many regions of our planet. Only in the relative climatic stability of the late Holocene—when all of humankind's written history has transpired—have our world's rivers taken on the geography we find familiar. Praetorius's chapter suggests that these ancient riverine movements were a force to reckon with for early human communities.

Even late Holocene rivers are restless—and, for human beings, rich: arteries of transit, places to fish and hunt. From the Yukon River Delta's open tundra, where Yup'ik communities use driftwood that has floated downstream from inland boreal forests to build homes on constantly shifting land, to the cultivation of the Nile's fertile valley, to the construction of dikes and berms, societies have long found ways to live with riverine movement. For millennia, people's actions have also influenced this movement. Agriculture, for example, often increased soil loss, which in turn altered downstream ecology, sediment deposition, and delta growth. Animal and microbial communities are often sensitive to water turbidity and shift as floodplains deposit or erode. The size and frequency of floods can influence vegetation by reshaping floodplains and depositing nutrients in the soil—or by abandoning channels through course shifts and avulsions. This, in turn, has contributed to dramatic changes in the organization of human societies.[6]

In addition to geologists, various historians, geographers, and archaeologists also provide essential perspectives on the long history of human societies with restless rivers.[7] Mapping six centuries of social and hydrological transformation with GIS techniques, Hong Jiang and Ian Rutherfurd show in "Six Centuries of Polders: Transforming the Jianghan Plain in China" how farmers, more than an all-powerful imperial state, in China's Jianghan Delta used levees and polders to shape a hydrology more amenable to agriculture—hydrology prone to politics and river movements alike. And, going across the globe to the Andes, Sandy Hunter's chapter, "Tracing the Urubamba: An Archaeohistory of an Andean River," analyzes archaeological evidence

DUKE UNIVERSITY PRESS

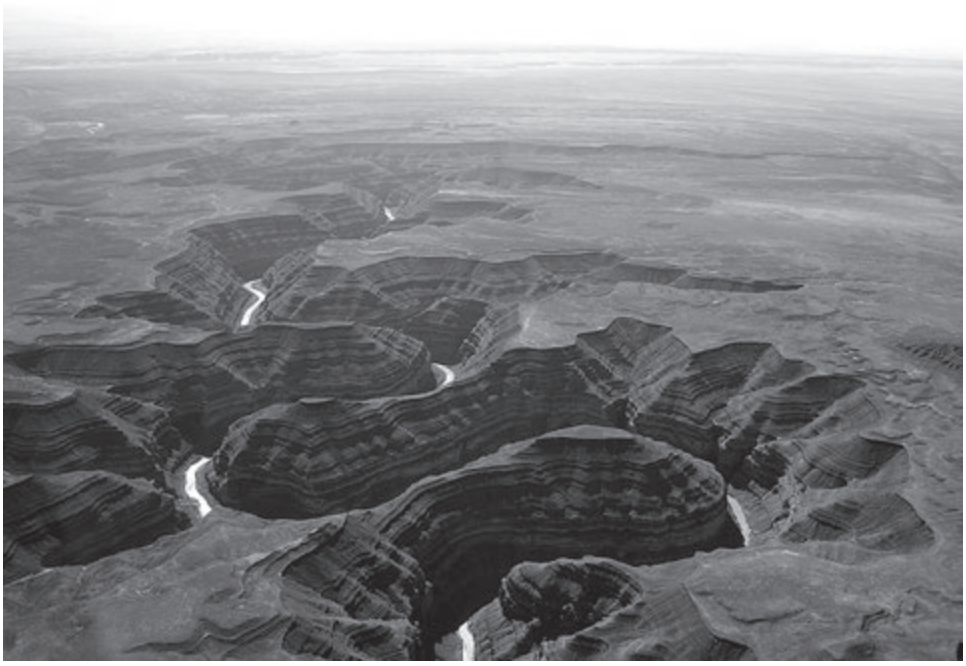


FIGURE 1.1. Today, the San Juan River continues to meander in Utah in the United States. The river carved its current path over a period of 300 million years. Photograph by Jitze Couperus, 2004. CC BY 2.0.

to explain how, to protect residents from floods and irrigate farmland, the Inca Empire channelized tributaries and meanders of the Urubamba through massive stoneworks. The result was a durable harnessing of the river's movement and power, which the Spanish Empire appropriated for its colonial ends and has continued into the present use of the Urubamba for hydroelectricity. Both chapters suggest that attempts to suppress shifting riverine morphologies and harness fluvial movement have a long history, one that begins before the modern period and crosses political regimes.

In the 1940s, US geologist Harold Fisk tried to map time from past paths of the Mississippi River. Using old maps, aerial photographs, and landscape observations, he and his team carefully reconstructed old courses of the river channel and overlaid them, using a different color for each past channel. By collapsing geological time into a fiction of simultaneity, his drawings showed a dynamic river constantly thrashing from its bed, bending and carving new paths toward the Gulf of Mexico. The constant movement of this river abruptly ceased less than two centuries ago, when modern engineering

DUKE UNIVERSITY PRESS

confined it between high levees and trapped its water and sediment behind dams. In "The Lower Mississippi River and the Novelty of Its Future Geology," Catherine Russell contends that Fisk's landscape is now an example of an Anthropocene river: Because it has been so changed by infrastructure, pollution, and other human interventions, its geology is fundamentally novel, with novel instabilities.

Moving across continents as well as across millennia and centuries, the chapters in this first section reveal a fundamental tension for river researchers: between examining the long history of rivers' restlessness and describing the scale, speed, and scope of modern attempts at riverine suppression. Rivers have always moved, and people have a long history of building dams, dikes, and other stabilizing technologies. Yet a deep-time view of rivers suggests that the scale of river transformation over the last two centuries dwarfs past attempts—in some cases, assuming geological proportions.

Fixing Rivers

The idea of what a river was, and what a river was for, was on the move by the nineteenth century. In the European Enlightenment, philosophers and writers who had long argued about the origin of rivers—were they born from underground channels bringing seawater inland, or from water collected from precipitation?—began to conceptualize rivers as watersheds, transporting rainfall and sediments released from mountains and soils. During the nineteenth century, state experts and colonial administrators started to collect systematic observations and measurements of precipitation, water flow, and sediments.[8] Rivers were no longer enigmatic or divine: They could be measured, mapped, and potentially controlled.

Industrializing, modern economies brought new reasons to seek riverine control. Fixing a river in a static channel and enclosing it between embankments, techniques long used to "reclaim" farmland from floodplains and deltas, expanded as modern engineering increased the quantity and effectiveness of such interventions, and modern economies and states increased the demand for dry land.[9] Dams multiplied, evening out seasonal variabilities in water quantity, expanding the reach of irrigation-intensive agriculture and making water-powered industry possible.[10] Industrial economies and colonial governments relied on stable waterways to transport commodities like coal, cotton, and timber.[11] The chapters in part II, contributed by historians and anthropologists, look at the struggles and consequences of the modernist understanding of rivers, one that prioritized putting water to work:

DUKE UNIVERSITY PRESS



FIGURE 1.2. The Arno River flows high behind embankments through Pisa, Italy. Photograph by portammare, 2014. CC BY-NC-ND 2.0.

fixing them in space, so their floods and banks were controlled to suit human needs, their power turned to economic ends (see figure 1.2). By focusing on riverine movement and embracing an expansive understanding of what a river is, these authors shed light on new facets of the modernist drive for control—and its contradictions.

Rivers provided more than power in the sense of energy or work: They were also part of state power, particularly around the creation of borders. Yet the movement of rivers challenged the desire for fixity inherent in border-making. As Sarah Sears's chapter, "Fixing the Rio Grande at the US-Mexico Border," shows, rivers became borders in a nineteenth-century world of emerging nation-states. But in the case of the Rio Grande, rivers made borders with a habit of moving, troubling the 1848 Treaty of Guadalupe Hidalgo until a channelization project "fixed" the river and the boundary between the United States and Mexico in geographical space. Andreas Mentrup-Womelsdorf's chapter, "Salmon, Imperial Formation, and the Creation of the Yukon River Border Zone, ca. 1900–1930," describes how Canadian officials became frustrated by the fixed national border at the 141st meridian, which

DUKE UNIVERSITY PRESS

curtailed their jurisdiction over Yukon River salmon in the late nineteenth and early twentieth centuries. For both authors, looking at rivers as more than water—as made by fish, politics, and erosion—allows them to show, in two places that are more than 3,000 miles (4,800 kilometers) from each other, the mobile, unruly place of rivers in defining and defying borders.

During the twentieth century, rivers were recruited into growth-focused economies. Planners conceived of projects as a form of social and economic engineering at the scale of entire watersheds—interventions often called "multipurpose river development" in the English-speaking world—that combined irrigation and drainage, hydroelectric energy generation, flood suppression, and navigation.[12] Crossing ideologies and cultures, these projects ranged from the Tennessee Valley Authority, built to electrify the rural United States and put the country to work during the Great Depression, to the mega-dams of the Soviet Union, some of which were planned to reverse the very direction of a river's current, a kind of socialist intervention against gravity itself. Such modernist visions of economic growth, and the habit of fixing and harnessing rivers to further intensive resource use and expanded consumption, went global during the Cold War.[13]

While many histories of twentieth-century dams emphasize the modernist triumphalism of river fixing, Giacomo Parrinello and Santiago Gorostiza contend in "The Politics of Sediment in the Nile's Aswan High Dam" that such megaprojects always had their critics. By expanding their sense of what a river is—focusing on silt and sedimentation—Parrinello and Gorostiza show how the construction of the Aswan Dam was an intervention not only in the Nile River's hydrology but also in its geology. Criticism of Aswan focused on the potentially catastrophic consequences of capturing the Nile's dynamic, silt-rich floodwaters behind the dam for the survival of its densely cultivated and inhabited delta. Fixing the river's hydrology, in other words, threatened to "unfix" the river's geology, thus casting a shadow on the modernist vision that justified the dam.

What to do with rivers was a question with global resonance by the late twentieth century, as watershed-scale river engineering spread across South and Southeast Asia, South America, and Africa, often alongside post–World War II decolonization movements. In their wake, many local social practices, developed to move with rivers' inherent changes, receded or disappeared altogether. Yet, across these chapters, attempts to suppress riverine dynamism consistently encountered the power of rivers themselves. A "fixed" river was often not the end of riverine movement but movement of a new kind.

DUKE UNIVERSITY PRESS

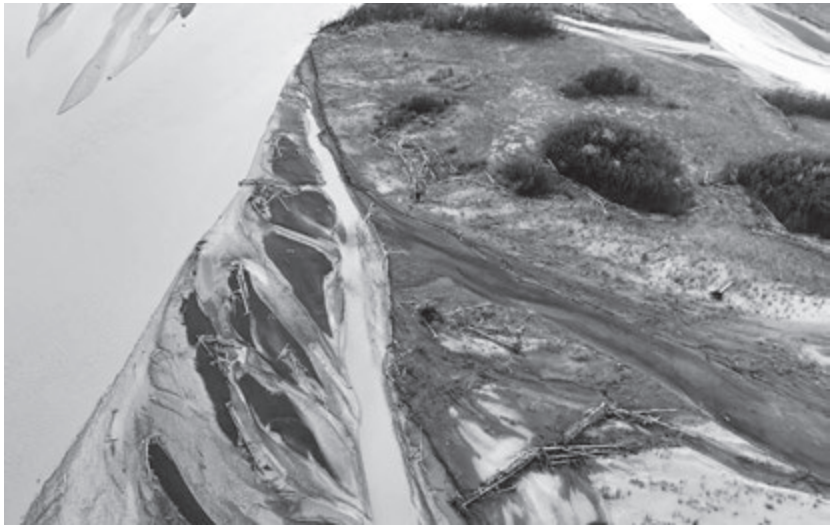


FIGURE 1.3. Driftwood and sedimentation occur at the confluence of the White River and the Yukon River in Canada. Photograph by Bathsheba Demuth, 2024.

Beyond Water

The natures of rivers themselves are moving in river scholarship: No longer the sites of twentieth-century engineering dreams, rivers are instead defined by how they connect and shape both land and sea. Biogeochemists track isotopes across watersheds, following the travels of carbon dioxide molecules from the air through the land and into the oceans.[14] Geomorphologists follow the transformation of mountains and hills into sediment particles that pass down river channels, shaping landscapes and nourishing beaches and deltas (see figure 1.3).[15] And, increasingly, rivers are places to examine intertwined physical and social relationships. Hydrologists model how water moves through a watershed and how it links with climate—climate that is in turn now altered by people.[16] Biologists examine how nutrients pass between microbes, plants, and animals, human and otherwise, in a watershed-spanning web.[17] These perspectives increasingly converge with those of social scientists, who track institutions, settlements, and production by weaving together the material worlds of hydrology, power, and land with values both economic and cultural. The chapters in part III—like many in this volume—contribute to the convergence of these varied perspectives, as the authors bring insights from hydrology and atmospheric science to their historical and anthropological studies.

DUKE UNIVERSITY PRESS

Seeing rivers as made from the relationships among isotopes, sediments, water, nutrients, biological life, and economic and political relations of human communities makes a river far more than just a channel of water. The result expands our sense of what a river is and how it can move. When embraced by historians, as in part III of this collection, such an expansive view of rivers allows them to tell new stories about how people have learned to live with riverine movements. The river in Valeria Mantilla Morales's chapter, "Colombia's Magdalena and the River as Labor," is perilous but essential to navigation for the Spanish Empire, a combination that gave particular agency to free Black boatmen. For Morales, the Magdalena was defined by the relationship of human muscle to geological and ecological conditions: Physical labor made the movements of people and commodities along the river possible, by interacting with the moving river itself. Only the advent of coal-powered boats in the nineteenth century broke this relationship. Seeing the river through these lenses offers fresh perspectives on power, freedom, and resistance in colonial rivers and beyond.

In "Rivers Without Water and the Colonization of Southern Africa," Anjuli Webster shows how the European colonial assumption that rivers enabled travel and economic exploration struggled with the hydrology of southern Africa, where most rivers have ephemeral, intermittent flows. Rivers, Webster argues, thus have social and political roles even when they contain no water at all—and the kind of politics a river helps shape is influenced by its ephemeral behavior. Nor, as Douglas McRae shows in "The Flying Rivers of Brazil," are rivers necessarily terrestrial. Looking at a component of the global water cycle, moisture exhaled into the atmosphere by Amazonian rainforests, McRae argues that airborne water became, for Brazilians, "flying rivers," a critical resource in times of drought and a prescient early example of the linked relationship between climate and rivers. These chapters show that what counts as a river also has implications for river politics: If British colonial authorities found rivers without water an obstacle to colonization, public consciousness of flying rivers motivated citizens to mobilize for water and forest conservation.

Thus, while the calculating rationality of modern engineering has often reduced rivers to water flows, and the Western cartographical imagination has transformed rivers into lines on maps, these chapters are an invitation to think of rivers that fly, rivers as borders, rivers made by geological cataclysm and by human engineering, and rivers that contain no water at all.[18] Viewed collectively, they contribute new ways of thinking about what a river is, how a river moves, and what kinds of politics different understandings of rivers on the move enable.

DUKE UNIVERSITY PRESS

Unfixing Rivers

Thinking of rivers in terms of the relationships that produce them is a relatively new framework in Western scholarship.[19] It is far less novel to many other intellectual traditions, including those of Indigenous societies. Drawing on training in history, fluvial geomorphology, rhetoric, and river ecology, the essays in part IV look for ways that rivers might be productively "unfixed" and reimagined, both in scholarship and materially.[20] Frequently, this includes directly countering the colonial and modernist power relationships that tried to hold rivers in place during the past century.[21] The close links between the Upper Mississippi River, the Ojibwe people, and *manoomin* (wild rice), have, as Elaine Stokes describes in "The Dammed Landscapes of Wild Rice Country on the Upper Mississippi," survived settler-colonial river management policies of the nineteenth and twentieth centuries. Now, in the twenty-first, Ojibwe principles of relationship with manoomin are shaping legal strategies focused on returning river governance to Mississippi headwater Tribes. Arguing that manoomin has the right to live in a healthy river is part of a larger movement—with examples in Canada, Ecuador, and New Zealand, among other countries—to grant rivers personhood and with it formal, legal protections.[22]

Thinking of rivers as social, relational entities—often shaped by colonization and imperial power—also makes them potential spaces for justice and reparation. As Caroline Gottschalk and Marty Holtgren detail in "The Island That Isn't an Island," unfixing the colonial expectations along Michigan's Maple River requires combining ecology, Indigenous and settler history, and hopes for the future. The result, they argue, re-stories the river—with the potential to change community understandings of what the Maple has been, what it could be, and who it could be for. Such conversations help river communities and river scholars alike think of rivers as more than channels of water, opening creative space to reflect on the myriad ways that rivers sustain life for our planet and its inhabitants. They can also help trace a way forward to different relationships with rivers, capable of combining the restoration of fluvial dynamism and the reparation of historical injustices.

The acceleration of climate change and biodiversity loss in the twenty-first century makes rethinking how we understand and engage with rivers unavoidable. As Francis J. Magilligan argues, in "River Restoration in Times of Climate Change," catastrophic floods are becoming all too normal and require a rethinking of hydrological planning—to un-dam rivers, remove levees, and otherwise consider how freeing rivers to move again can create

DUKE UNIVERSITY PRESS



FIGURE 1.4. The floodplain of the Severn River in Great Britain is inundated. Photograph by Kumweni, 2015. CC BY 2.0.

new resiliencies for riverine ecologies and societies (see figure 1.4). The conclusion to this book by Mark A. Healey and Laurence C. Smith brings together deep-time riverine movement patterns with the contemporary state of rivers around the planet to reflect on the possibilities and challenges of living with rivers on the move in a future of inescapable and necessary change.

From floods so cataclysmic they tore the Columbia River Valley through stone at the end of the last ice age, to centuries-old dikes and canals in Asia and South America, to nineteenth-century borderland rivers, twentieth-century engineered rivers, and twenty-first-century rivers coming unfixed from their dams and colonial legacies, this book follows a diverse range of rivers moving and being moved. Collectively, these chapters join an emerging, interdisciplinary body of literature on rivers that goes beyond questioning when a river is "natural" or becomes "artificial" due to human interventions—or seeing rivers as "hybrids" of society and nature—to look instead at how rivers move, the consequences of trying to fix them, and potential ways of living with "unfixed" rivers.[23] In other words, these chapters join a scholarly

DUKE UNIVERSITY PRESS

conversation that takes it as a given that people live with, change, and are changed by rivers. The question is how to do so in our current century—to think through how societies and increasingly volatile rivers might move together in the future.

Many other stories await outside this volume: of European rivers in war and peace; of the mountainous, repeatedly dammed rivers of Japan or the Congo River basin's unusual hydrology and boat-blocking, energy-producing cascades; of the massive replumbing of headwaters in China and India; or of rivers as homes and shapers of religion, to name a small sample.[24] There are few fish and no freshwater dolphins in *Rivers on the Move*, some forests but few pastures, and no examination of divergent water pollution trajectories around the world. What these far-ranging essays do bring to the fore, however, is an argument for seeing rivers as never fixed—a vitality that can be better understood by expanding our notions of what a river is and how a river is known.

As floods break down banks and water vanishes in droughts, as deltas fill with salt from rising seas and glacial headwaters dwindle, the ways climate change transforms rivers are visible—and often destructive. But transformation does not need to bring disaster, if it is accompanied by a profound revision of the way rivers are understood and managed. *Rivers on the Move* shows how attempts to fix rivers have always been troubled and partial, and this volume argues that continuing to force static forms and functions on rivers is only growing less tenable in our unpredictable present. And trying to make rivers in the present look like rivers in the past—to fix them in time as well as in space—runs the risk of compounding calamity when rivers will eventually do as they must: move. Our hope is that this book will foster more research and storytelling about the mobile lives of rivers, as well as dialogues about new ways to live with rivers' dynamism on our ever-changing planet.

Notes

1 Wohl, "Rivers in the Anthropocene," 10660.

2 Mauch and Zeller, "Rivers in History and Historiography"; Evenden, "Beyond the Organic Machine?"; Schönach, "River Histories"; and Benson, "Rivers in History."

3 Wohl, *Virtual Rivers* and *A World of Rivers*; Kondolf, "Hungry Water"; Winiwarter et al., "Looking at Half a Millennium"; Mostern, *Yellow River*. See also Kelly et al., *Rivers of the Anthropocene*; Gamble et al., *Rivers of the Asian Highlands*; and Scott, *In Praise of Floods*.

4 A note on our citations: The works referenced in this introduction are not meant to be comprehensive but offer a sampling of the kinds of interdisciplinary river

DUKE UNIVERSITY PRESS

research the editors drew from in conceiving the original call for papers that became this collection and in thinking about how the chapters in this volume contribute to contemporary scholarship. As Evenden's, Benson's, and Schönach's review articles show, the environmental history work on rivers alone is too vast to cover in a short introduction, let alone a full overview of all the relevant fields.

5 On the Mississippi, see, for example, Potter-McIntyre et al., "Maastrichtian Birth of the Ancestral Mississippi," and Chamberlain et al., "Anatomy of Mississippi Delta Growth."

6 See, for example, two recent contributions that speculate on the link between the shifting morphology of the Nile and major transformations of ancient Egypt: Peeters et al., "Shift Away from Nile Incision at Luxor," and Ghoneim et al., "Egyptian Pyramid Chain."

7 See, for example, Mostern, *Yellow River*; Zhang, *River, the Plain*; VanValkenburgh, *Alluvium and Empire*; and Edgeworth, *Fluid Pasts*.

8 For a water-centered account of these processes, see Linton, *What Is Water?* See also the thought-provoking argument by Da Cunha in *The Invention of Rivers* that dates this process back to Alexander the Great.

9 For examples of these processes, see Blackbourn, *Conquest of Nature*, and Mostern, *Yellow River*. Bhattacharyya, in *Empire and Ecology in the Bengal Delta*, emphasizes the role of law alongside hard infrastructure. For an overview of some of the main themes of river history, see also Middleton, *Rivers*, chapter 3.

10 Environmental historians have a long tradition of writing about rivers. In addition to works cited elsewhere, a chronological selection of this historiography includes Worster, *Rivers of Empire*; Scarpino, *Great River*; Tvedt and Jakobsson, *History of Water Vol. 1*; Cioc, *Rhine*; and Pritchard, *Confluence*.

11 See, for example, Upholt, *Great River*.

12 Molle, "River-Basin Planning and Management." For examples of how modernist dreams shaped rivers and other bodies of water, see Jakobsson, "Industrialization of Rivers"; Amrith, *Unruly Waters*; Hoag, *Developing the Rivers*; Gilmartin, *Blood and Water*; and Peterson, *Pipe Dreams*.

13 Sneddon, *Concrete Revolution*.

14 Gaillardet, *La terre*, especially chapter 2.

15 Wohl et al., "Connectivity as an Emergent Property."

16 Shrestha et al., "Future Hydrology and Hydrological Extremes," and Yang et al., "Hydrological Cycle and Water Resources."

17 Hilderbrand et al., "The Roles of Microbes."

18 For other work that expands our sense of what rivers are, see Cipolla and Allard, "Recognizing River Power"; Best et al., "Beyond Just Floodwater"; Parrinello and Kondolf, "Social Life of Sediment"; and Zeiderman, *Artery*.

19 Wymore et al., "Viewing River Corridors." For a sample of the rich Indigenous scholarship on water and rivers, see Todd, "Fish, Kin, and Hope"; Curley, "Unsettling Indian Water Settlements"; and Emanuel, *On the Swamp*.

20 For more work along these lines, see Serra-Llobet et al., "Restoring Rivers and Floodplains"; Penaluna et al., "Using Natural Disturbance"; and Jeffers,

DUKE UNIVERSITY PRESS

"Environmental Knowledge." Evenden also discusses Anthropocene rivers in "Beyond the Organic Machine?"

21 See also Boelens et al., "Riverhood."

22 For work on the rights of rivers, see Macfarlane, *Is a River Alive?*, and de Toledo, *Le fleuve qui voulait écrire*.

23 White, *Organic Machine*. Evenden has emphasized how climate change and the Anthropocene leads historians to moving past the important insights of White in "Beyond the Organic Machine?," 719–20. This applies to river scholarship writ large. Thinking about rivers on the move, as this volume does, is one way to do so.

24 On religion and rivers, see Protass, "Riverine Buddhism"; Abé, "Mountains, Waters, and Dharmakāya"; and forthcoming work from Nathaniel Moses and Yu-Cheng Shih.

Bibliography

Abé, Ryūichi. "Mountains, Waters, and Dharmakāya: Kūkai's Irrigation Projects." In *Countless Sands: Medieval Buddhists and Their Environments*, edited by Jeffery Moser and Jason Protass, 281–306. University of Hawai'i Press, 2024.

Amrith, Sunil. *Unruly Waters: How Rains, Rivers, Coasts and Seas Have Shaped Asia's History*. Basic Books, 2019.

Benson, Etienne. "Rivers in History: Systems, Agents, and Places." In *The Handbook of the Historiography of the Earth and Environmental Sciences*, edited by Elena Aronova, David Sepkoski, and Marco Tamborini, 1–17. Springer, 2024.

Best, Jim, Peter Ashmore, and Stephen E. Darby. "Beyond Just Floodwater." *Nature Sustainability* 5, no. 10 (2022): 811–13.

Bhattacharyya, Debjani. *Empire and Ecology in the Bengal Delta: The Making of Calcutta*. Cambridge University Press, 2018.

Blackbourn, David. *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany*. W. W. Norton, 2006.

Boelens, Rutgerd, Arturo Escobar, Karen Bakker, et al. "Riverhood: Political Ecologies of Socionature Commoning and Translocal Struggles for Water Justice." *Journal of Peasant Studies* 50, no. 3 (2022): 1125–56. doi:10.1080/03066150.2022.2120810.

Chamberlain, Elizabeth L., Torbjörn E. Törnqvist, Zhixiong Shen, Barbara Mauz, and Jakob Wallinga. "Anatomy of Mississippi Delta Growth and Its Implications for Coastal Restoration." *Science Advances* 4, no. 4 (2018). doi:10.1126/sciadv.aar4740.

Cioc, Mark. *The Rhine: An Eco-Biography, 1815–2000*. University of Washington Press, 2002.

Cipolla, Craig N., and Amélie Allard. "Recognizing River Power: Watery Views of Ontario's Fur Trade." *Journal of Archaeological Method and Theory* 26 (2019): 1084–105.

Curley, Andrew. "Unsettling Indian Water Settlements: The Little Colorado River, the San Juan River, and Colonial Enclosures." *Antipode* 53, no. 3 (2021): 705–23.

Da Cunha, Dilip. *The Invention of Rivers: Alexander's Eye and Ganga's Descent*. University of Pennsylvania Press, 2018.

DUKE UNIVERSITY PRESS

De Toledo, Camille, ed. *Le fleuve qui voulait écrire: Les auditions du parlement de la Loire*. Les Liens Qui Libèrent, 2021.
Edgeworth, Matthew. *Fluid Pasts: Archaeologies of Flow*. Bloomsbury, 2011.
Emanuel, Ryan E. *On the Swamp: Fighting for Indigenous Environmental Justice*. University of North Carolina Press, 2024.
Evenden, Matthew. "Beyond the Organic Machine? New Approaches in River Historiography." *Environmental History* 23, no. 4 (2018): 698–720. https://doi.org/10.1093/envhis/emy054.
Gaillardet, Jérôme. *La terre habitable ou l'épopée de la zone critique*. La Découverte, 2023.
Gamble, Ruth, Gillian G. Tan, Hongzhang Xu, et al. *Rivers of the Asian Highlands: From Deep Time to the Climate Crisis*. Routledge, 2024.
Ghoneim, Eman, Timothy J. Ralph, Suzanne Onstine, et al. "The Egyptian Pyramid Chain Was Built Along the Now Abandoned Ahramat Nile Branch." *Communications Earth & Environment* 5, no. 1 (2024): 1–13. https://doi.org/10.1038/s43247-024-01379-7.
Gilmartin, David. *Blood and Water: The Indus River Basin in Modern History*. University of California Press, 2015.
Hilderbrand, Robert H., Ted Bambakidis, and Byron C. Crump. "The Roles of Microbes in Stream Restorations." *Microbial Ecology* 85, no. 3 (April 1, 2023): 853–61. https://doi.org/10.1007/s00248-023-02179-w.V.
Hoag, Heather J. *Developing the Rivers of East and West Africa*. Bloomsbury, 2013.
Jakobsson, E. "Industrialization of Rivers: A Water System Approach to Hydropower Development." *Knowledge, Technology and Policy* 14 (2002): 41–56.
Jeffers, J. M. "Environmental Knowledge and Human Experience: Using a Historical Analysis of Flooding in Ireland to Challenge Contemporary Risk Narratives and Develop Creative Policy Alternatives." *Environmental Hazards* 13, no. 3 (2014): 229–47.
Kelly, Jason M., Philip Scarpino, Helen Berry, James Syvitski, and Michel Meybeck, eds. *Rivers of the Anthropocene*. University of California Press, 2018.
Kondolf, Mathias G. "Hungry Water: Effects of Dams and Gravel Mining on River Channels." *Environmental Management* 21, no. 4 (1997): 533–51. https://doi.org/10.1007/s002679900048.
Linton, Jamie. *What Is Water? The History of a Modern Abstraction*. University of British Columbia Press, 2010.
Macfarlane, Robert. *Is a River Alive?* W. W. Norton, 2025.
Mauch, Christof, and Thomas Zeller. "Rivers in History and Historiography: An Introduction." In *Rivers in History: Perspectives on Waterways in Europe and North America*, edited by Christof Mauch and Thomas Zeller, 1–10. University of Pittsburgh Press, 2008.
Middleton, Nick. *Rivers: A Very Short Introduction*. Oxford University Press, 2012.
Molle, François. "River-Basin Planning and Management: The Social Life of a Concept." *Geoforum*, Themed Issue: Gramscian Political Ecologies, 40, no. 3 (2009): 484–94. https://doi.org/10.1016/j.geoforum.2009.03.004.
Mostern, Ruth. *The Yellow River: A Natural and Unnatural History*. Yale University Press, 2021.

DUKE UNIVERSITY PRESS

Parrinello, Giacomo, and G. Mathias Kondolf. "The Social Life of Sediment." *Water History* 13 (June 2021): 1–12.

Peeters, Jan, Angus Graham, Willem H. J. Toonen, et al. "Shift Away from Nile Incision at Luxor ~4,000 Years Ago Impacted Ancient Egyptian Landscapes." *Nature Geoscience* 17 (May 29, 2024): 1–9. https://doi.org/10.1038/s41561-024-01451-z.

Penaluna, B. E., Gordon H. Reeves, Zanethia C. Barnett, et al. "Using Natural Disturbance and Portfolio Concepts to Guide Aquatic–Riparian Ecosystem Management." *Fisheries* 43, no. 9 (2018): 406–22.

Peterson, Maya K. *Pipe Dreams: Water and Empire in Central Asia's Aral Sea Basin*. Cambridge University Press, 2019.

Potter-McIntyre, Sally L., Jeremy R. Breeden, and David H. Malone. "A Maastrichtian Birth of the Ancestral Mississippi River System: Evidence from the U-Pb Detrital Zircon Geochronology of the McNairy Sandstone, Illinois, USA." *Cretaceous Research* 91 (November 1, 2018): 71–79. https://doi.org/10.1016/j.cretres.2018.05.010.

Pritchard, Sara B. *Confluence: The Nature of Technology and the Remaking of the Rhône*. Harvard University Press, 2011.

Protass, Jason. "Riverine Buddhism at Changlu Monastery." In *Countless Sands: Medieval Buddhists and Their Environments*, edited by Jeffery Moser and Jason Protass, 163–94. University of Hawai'i Press, 2024.

Scarpino, Philip V. *Great River: An Environmental History of the Upper Mississippi, 1890–1950*. University of Missouri Press, 1985.

Schönach, Paula. "River Histories: A Thematic Review." *Water History* 9, no. 3 (2017): 233–57. https://doi.org/10.1007/s12685-016-0188-4.

Scott, James C. *In Praise of Floods: The Untamed River and the Life It Brings*. Yale University Press, 2025.

Serra-Llobet, Anna, Sonja C. Jähnig, Juergen Geist, et al. "Restoring Rivers and Floodplains for Habitat and Flood Risk Reduction: Experiences in Multi-Benefit Floodplain Management from California and Germany." *Frontiers in Environmental Science* 9 (2022). https://doi.org/10.3389/fenvs.2021.778568.

Shrestha, Sangam, Deg-Hyo Bae, Panha Hok, Suwas Ghimire, and Yadu Pokhrel. "Future Hydrology and Hydrological Extremes Under Climate Change in Asian River Basins." *Nature Scientific Reports* 11, no. 17089 (2021). https://doi.org/10.1038/s41598-021-96656-2.

Sneddon, Christopher. *Concrete Revolution: Large Dams, Cold War Geopolitics, and the US Bureau of Reclamation*. University of Chicago Press, 2015.

Todd, Zoe. "Fish, Kin, and Hope: Tending to Water Violations in Amiskwaciwâskahikan and Treaty Six Territory." *Afterall: A Journal of Art, Context and Inquiry* 43, no. 1 (2017): 102–7.

Tvedt, T., and E. Jakobsson, eds. *A History of Water Vol. 1: Water Control and River Biographies*. Tarius, 2006.

Upholt, Boyce. *The Great River: The Making and Unmaking of the Mississippi*. W. W. Norton, 2024.

VanValkenburgh, Parker. *Alluvium and Empire: The Archaeology of Colonial Resettlement and Indigenous Persistence on Peru's North Coast*. University of Arizona Press, 2021.

DUKE UNIVERSITY PRESS

Winiwarter, Verena, Martin Schmid, and Gert Dressel. "Looking at Half a Millennium of Co-Existence: The Danube in Vienna as a Socio-Natural Site." *Water History* 5, no. 2 (2013): 101–19. https://doi.org/10.1007/s12685-013-0079-x.

White, Richard. *The Organic Machine: The Remaking of the Columbia River*. Hill and Wang, 1995.

Wohl, Ellen. "Rivers in the Anthropocene: The U.S. Perspective." *Geomorphology, the Binghamton Geomorphology Symposium: 50 Years of Enhancing Geomorphology* 366 (2020). https://doi.org/10.1016/j.geomorph.2018.12.001.

Wohl, Ellen. *Virtual Rivers: Lessons from the Mountain Rivers of the Colorado Front Range*. Yale University Press, 2001.

Wohl, Ellen. *A World of Rivers: Environmental Change on Ten of the World's Great Rivers*. University of Chicago Press, 2011.

Wohl, Ellen, Gary Brierley, Daniel Cadol, et al. "Connectivity as an Emergent Property of Geomorphic Systems." *Earth Surface Processes and Landforms* 44, no. 1 (2019): 4–26. https://doi.org/10.1002/esp.4434.

Worster, Donald. *Rivers of Empire: Water, Aridity, and the Growth of the American West*. Pantheon, 1985.

Wymore, Adam S., Adam S. Ward, Ellen Wohl, and Judson W. Harvey. "Viewing River Corridors Through the Lens of Critical Zone Science." *Frontiers in Water* 5 (2023). https://www.frontiersin.org/articles/10.3389/frwa.2023.1147561.

Yang, Dawen, Yuting Yang, and Jun Xia. "Hydrological Cycle and Water Resources in a Changing World: A Review." *Geography and Sustainability* 2, no. 2 (2021): 115–22.

Zeiderman, Austin. *Artery: Racial Ecologies on Colombia's Magdalena River*. Duke University Press, 2025.

Zhang, Ling. *The River, the Plain, and the State: An Environmental Drama in Northern Song China, 1048–1128*. Cambridge University Press, 2016.

DUKE UNIVERSITY PRESS