

# Connecticut River Flow Restoration Study

## STUDY OVERVIEW

For the full Study Report, go to: [nature.org/ctriverwatershed](https://nature.org/ctriverwatershed)

*A new study provides insight on dams,  
water flows, and restoration potential*

JUNE 2018

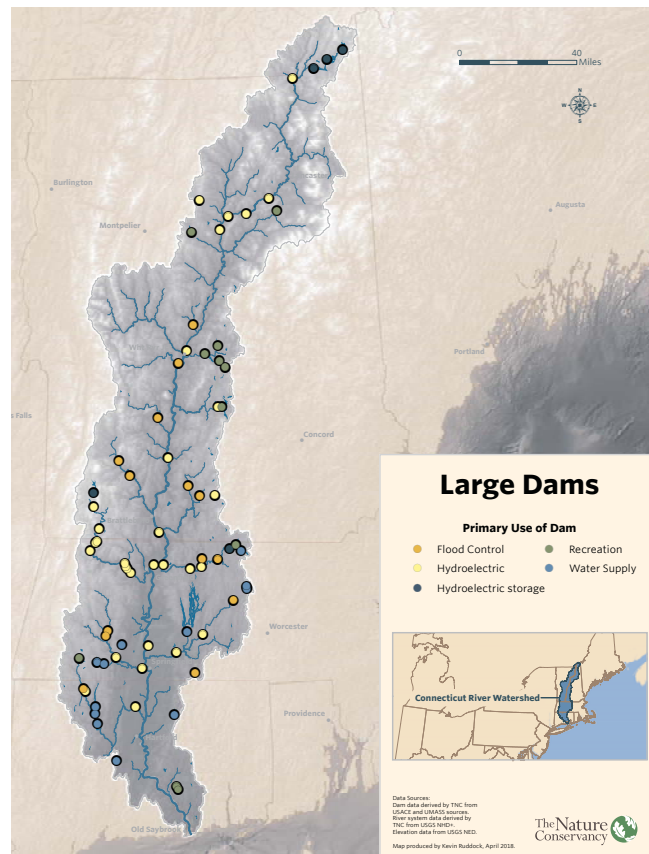


# Managing the Connecticut River for Nature and People

The Connecticut River begins in silence, unseen—in a tiny beaver pond, just yards from the Canadian border. Here among the moss and sedges, water bubbles from the earth, cool and clear, gathering strength, building momentum, winding south for 410 miles before it spills into Long Island Sound. Along the way, the Connecticut more than lives up to its Native American name. It is, in fact, “a long tidal river,” and it weaves a pulsing watery network across four states and 7.2 million acres—the largest freshwater ecosystem in New England.

From its headwater streams, through field and forest, city and village, to the tidal marshes at the end of its journey, the Connecticut River has long been a source of sustenance for both people and nature, a complex system facing competing demands and a host of challenges. The sweeping watershed supplies drinking water for 2.3 million people, including residents of major cities like Springfield, Massachusetts, and Hartford, Connecticut, and it fills reservoirs that provide water to another 2.5 million people in the Boston area. The watershed is also home to a rich mix of species that depend on the river for survival. American shad, alewife, and other migratory fish return to these waters to spawn. Native species like brook trout, longnose dace, fallfish, and tessellated darter thrive here. And along the banks of the river, countless species of mammals and reptiles, raptors and songbirds take refuge in the floodplain forests.

For generations, the natural flow of the Connecticut River shaped the habitat within and along its shores, helping migratory fish travel upstream, carrying seeds to new planting grounds, and spreading rich river sediment across the floodplain forests. But as human settlement grew, the river went to work in new ways. Dams sprang up throughout the watershed, providing critical flood management and generating vital energy for towns and cities. Today, the Connecticut River, fractured by more than 3,000 dams, is one of the most heavily dammed waterways in all of North America. Some of these structures are obsolete and ready for removal; many are doing the important work of sustaining and protecting human communities. All of them disrupt the natural flow, deeply affecting fragile ecosystems and forever changing the river’s rhythm and pulse.



*“The purpose of the Connecticut River Flow Restoration Study was to evaluate the feasibility of operational changes at large dams throughout the watershed to benefit ecological health and function while maintaining the important services provided by these dams.”*





## WHAT'S AT STAKE A Study in Search of Solutions

Is there a way to address the needs of both nature and people along the Connecticut River, protecting fragile ecosystems while also supporting human communities? This was the question that sparked the **Connecticut River Flow Restoration Study**—and a search for answers. Initiated by The Nature Conservancy and the U.S. Army Corps of Engineers (USACE), and completed this spring, the study set out to examine whether operational changes at the watershed's largest dams could restore more natural flow patterns, creating environmental benefits, while maintaining important services, including drinking water, flood management, and hydropower. The study—the first of its kind in the Connecticut River watershed—focused specifically on 14 flood-management dams operated by the USACE. Other partners collaborating on the study included the U.S. Geological Survey, the University of Massachusetts Amherst's Department of Environmental and Water Resource Engineering, and the USACE Hydrologic Engineering Center.

The team of scientists and engineers developed three watershed-scale models designed to help tell the story of the Connecticut River and its changing flow patterns. Each model offers a different perspective, explaining past, present, and future flows and providing the basis for potential improvements in dam management.

**Past:** The first model describes what the flows may have been like before development and dam operation.

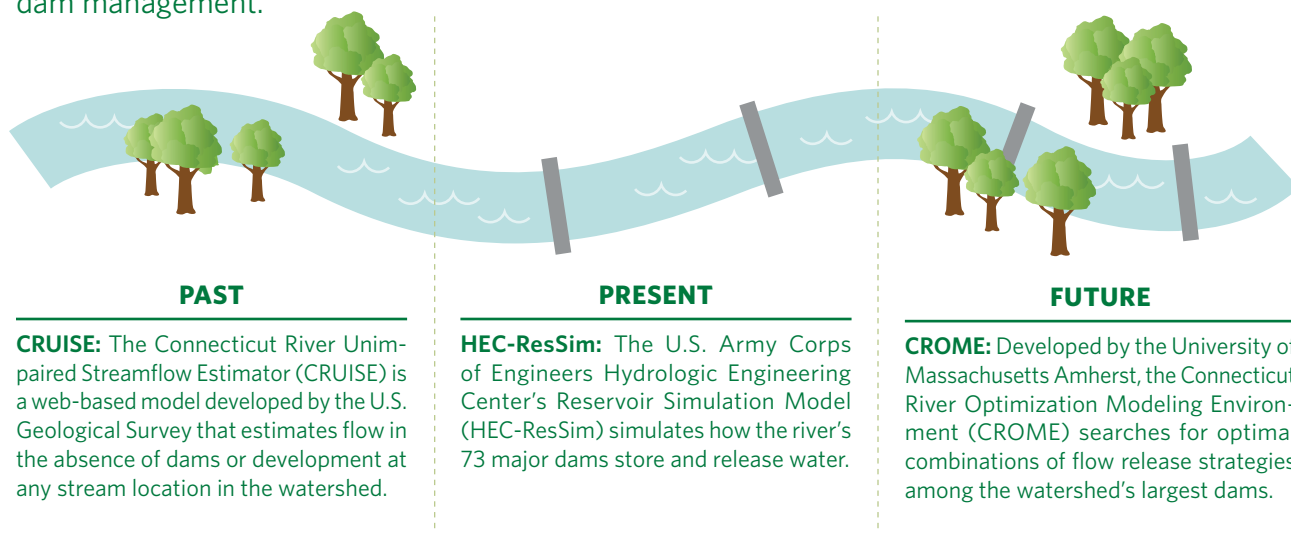
**Present:** The second model describes today's flow patterns, created by the current approach to dam management on the river.

**Future:** The third model, based on the first two, explores how future flows from dams might be adjusted to create environmental benefits.



### THREE FLOW MODELS

The study's three watershed-scale models help tell the story of the Connecticut River and its changing flow patterns. Each model offers a different perspective, explaining past (CRUISE), present (HEC-ResSim), and future (CROME) flows and providing the basis for potential improvements in dam management.



#### PAST

**CRUISE:** The Connecticut River Unimpaired Streamflow Estimator (CRUISE) is a web-based model developed by the U.S. Geological Survey that estimates flow in the absence of dams or development at any stream location in the watershed.

#### PRESENT

**HEC-ResSim:** The U.S. Army Corps of Engineers Hydrologic Engineering Center's Reservoir Simulation Model (HEC-ResSim) simulates how the river's 73 major dams store and release water.

#### FUTURE

**CROME:** Developed by the University of Massachusetts Amherst, the Connecticut River Optimization Modeling Environment (CROME) searches for optimal combinations of flow release strategies among the watershed's largest dams.

## FINDINGS What the Models Confirm

The first two models, describing the past and current flows, taken together, confirm the significant impact dams are having on the river and the ecosystems that once depended on natural flows in order to thrive:

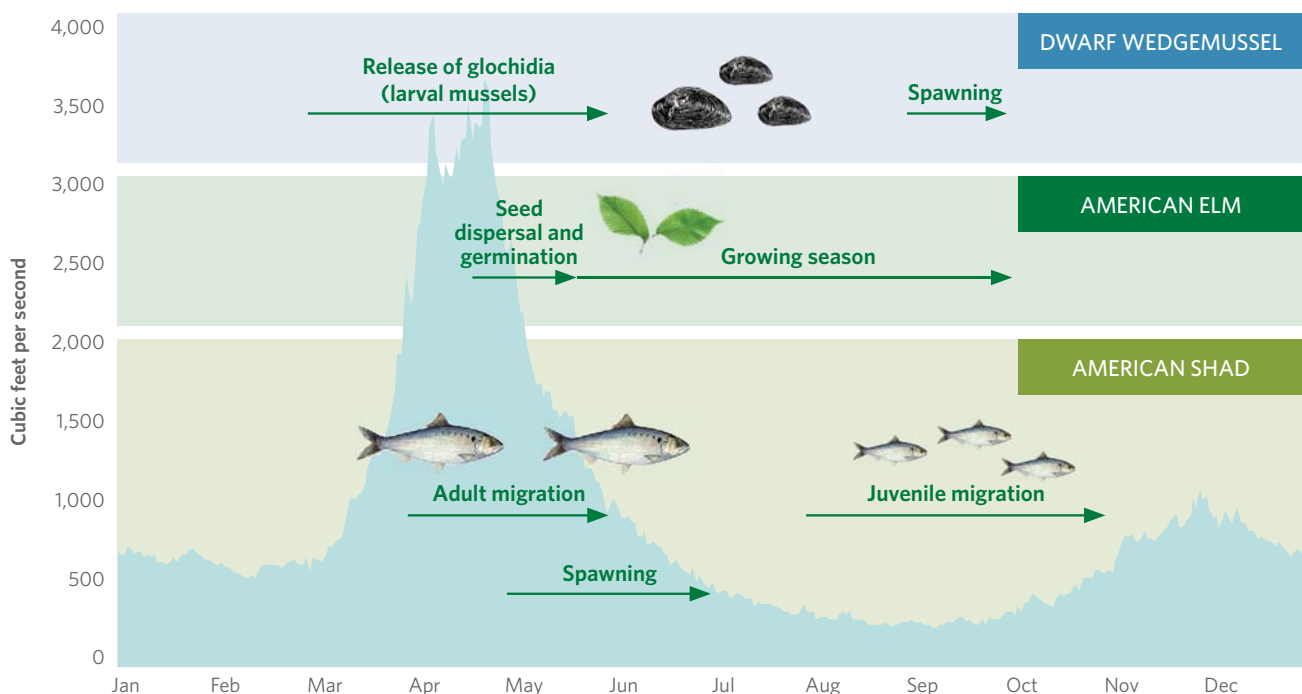
- **Seasonal High Flows:** Floodplain forests need water—lots of it. For generations, before the dams went in, the Connecticut River regularly overflowed its banks, spreading rich sediment across the earth, nourishing the forests along the water's edge, creating vibrant wildlife habitat. Today, some dams disrupt the natural rise and fall of the river, preventing the flooding so critical to a healthy floodplain ecosystem. Without these high-flow events, the area's once-expansive floodplain forests are shrinking, impacting the wildlife that depend on these riverside forests for survival.
- **Seasonal Low Flows:** Seasonal times of low flow, too, are critical for a healthy river. For many species, shallow habitat is ideal for spawning, and young plants and animals thrive

in the warm and steady flows that traditionally define the summer months. But many dams impede these natural low flows, in some cases causing the water to be so low that the river loses its connection to the floodplain, habitat goes dry, and fish and other aquatic species are left stranded. In other cases, the water may be running too high during what would naturally be a low-flow period, disrupting critical life cycles.

- **Daily Flows:** Even within the space of a single day, the water moving through an unobstructed river has a natural "sub-daily" pattern of flow. Hydropower dams, with their ability to control the timing and flow of water to generate electricity when it's needed most, can interrupt these natural flow patterns. Sometimes these dam operations cause drastic variations in the river's flow and temperature, resulting in repeated extreme changes in habitat that can be life-threatening for many species.

## THE NATURAL FLOW REGIME

The annual pattern of river flow is critical to key life stages of plants and animals living in and along our rivers.





## NATURAL WONDERS

The Connecticut River is full of natural wonders. Migrating fish return to the river again and again, drawn each year to their spawning grounds in an ancient ritual of nature. Endangered populations of tiny beetles burrow in narrow sandbars sculpted by the river. And twelve species of freshwater mussels, some of them threatened or endangered, depend for survival on the river's steady flows and cool temperatures. The forest that grows along the banks of the Connecticut, once expansive, offers protection to people, too, a natural buffer during times of severe flooding. Creating a sustainable future for the river means it will continue to protect both the natural and human communities that depend on these waters.

**① Migratory and Resident Fishes:** The Connecticut River supports 13 species of migratory fish, including American eel, alewife, and American Shad. Native resident fish species include longnose dace, fallfish, brook trout, and tessellated darter, among many others. When dams disrupt natural flow patterns, the life cycles of the organisms that depend on the natural flow are also disrupted. For example, modified flows may decrease connectivity of the river with its floodplain, reducing the creation and replenishment of backwaters used by some species for spawning and juvenile rearing. Dams and other barriers often prevent migratory fish from reaching their spawning grounds or increase the effort necessary to reach their destination.

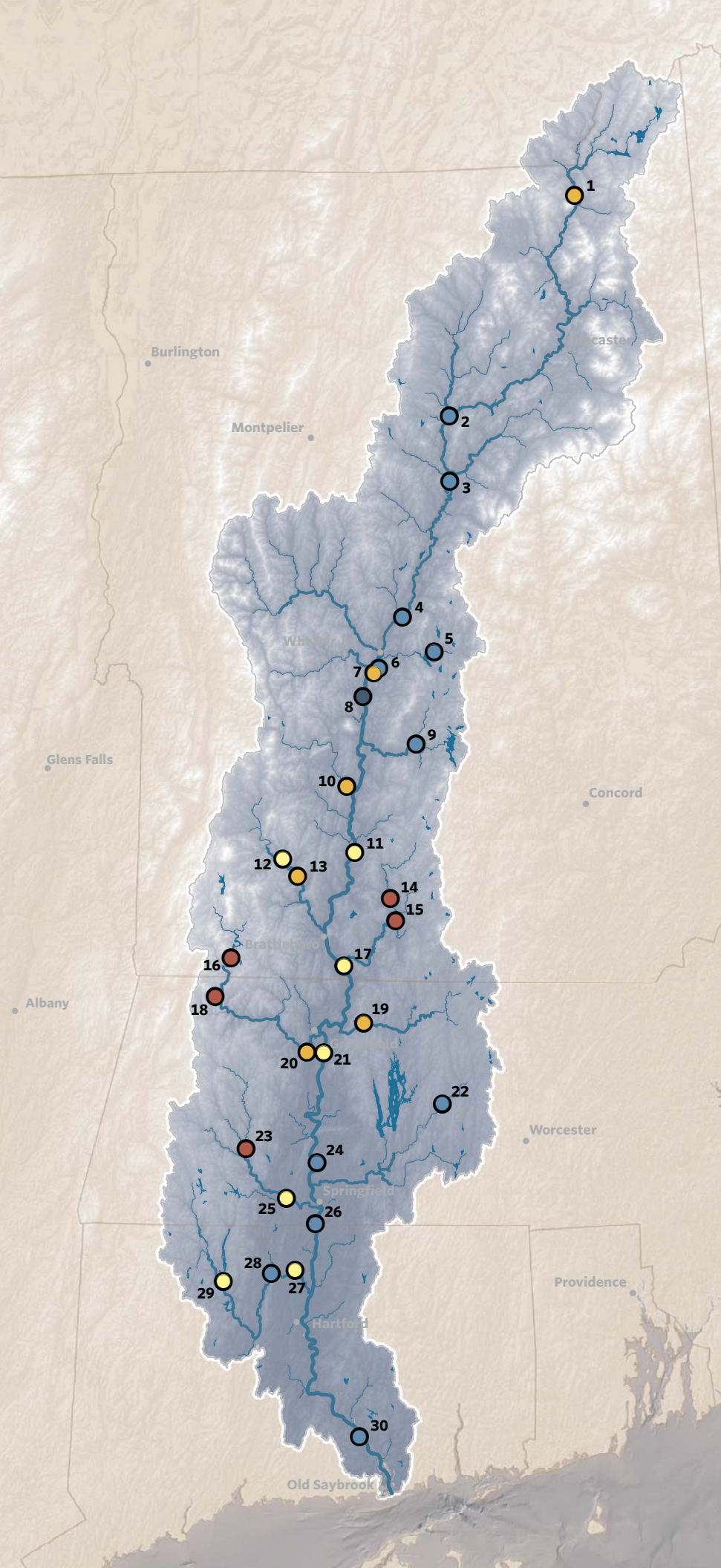
**② Floodplain Forests:** Floodplain forests are highly productive habitats that attract many species of wildlife, including fish (when the land is flooded and connected to the river), amphibians, reptiles, mammals, raptors, songbirds, and waterfowl. To maintain their distinct species assemblages and ecological processes, floodplain forests require periodic flooding, such

as annual multi-day floods, which are necessary to prevent more competitive upland trees and invasive non-native shrubs from displacing native floodplain plant species.

**③ Freshwater Mussels:** Twelve species of freshwater mussels are found in the Connecticut River watershed, including the brook floater, yellow lampmussel and dwarf wedgemussel. Nearly all freshwater mussel species living in rivers have been impacted by the fragmentation and altered flows created by dams. While precise reasons for the decline in freshwater mussel populations are not completely clear, evidence suggests that habitat changes related to flow alteration is one likely cause.

**④ Tiger Beetles:** Riparian tiger beetles live exclusively on narrow bars of sand and cobble at the river's edge. Since dams and their impoundments have reduced the number of sand and cobble bar habitats in the watershed, especially in the mainstem river, provision of adequate flows and sediment delivery is essential to preserving the remaining beetle habitat and to ensuring the survival of these small, but important, members of the ecological community.





# High Flow Impacts

## Impact of Dam Operations

- No Large or Small Floods
- No Large Floods
- No Recurring Large Floods
- Loss in Variation of Large Floods
- Minimal Alteration of Floods



Data Sources:  
 Dam data derived by TNC from  
 USACE and UMASS sources.  
 River system data derived by  
 TNC from USGS NHD+.  
 Elevation data from USGS NED.

Map produced by Kevin Ruddock, April 2018.

## MOVING FORWARD Complex River, Complex Answers

---

The Connecticut River Flow Restoration Study confirmed that the challenges facing this hard-working river are complex—and require innovative and holistic solutions. The modeling effort proved useful for evaluating the potential for flow restoration through changes in dam operations, but also highlighted the importance of alternatives to traditional flow management—the need for creative vision and big-picture thinking as we look ahead to the future of the great Connecticut River.

- **Limits of Dam Management:** While the purpose of the study was to find ways to re-operate large dams in the watershed for environmental benefits, the models demonstrated that, given their structural and operational constraints, the 14 USACE dams offer little potential to provide these benefits through flow management. Because water at these dams is either held back or released in response to safety needs, flows that might benefit nature are unlikely to be achieved without increasing the risk of flooding and property damage.
- **Alternative Strategies:** Although simple changes in flow management may not be enough to restore the river and shape a more sustainable future, the study suggests alternative strategies that could provide useful solutions. Structural improvements to dams, for example, offer the possibility of increased flexibility for dam operators, so that beneficial flows can be provided for downstream species.

Targeted land management, including the purchase of protective easements, is another important conservation tool that could help preserve the open space the river needs to provide critical habitat for wildlife and natural buffers for human communities during flooding. And restoration of existing floodplains is a strategy already in use along the banks of the Connecticut River, demonstrating the power of natural solutions. All of these alternatives, of course, will demand thoughtful consideration, a careful weighing of tradeoffs, a balancing of the risks and returns for many different stakeholders.



- **Models at Work:** Some of the models developed for the study have already become useful tools for resource managers, helping to guide difficult water allocation and management choices, such as the once-in-a-generation relicensing process for five of the river's largest hydropower projects—where decisions have the potential to impact more than 150 miles of the mainstem Connecticut River. Because these science-based models provide a greater understanding of the river, they can be powerful tools in reducing conflict, as stakeholders come to the table in search of solutions to the complexities of managing the river's many uses, balancing the needs of human communities, while also trying to protect the environment.

Ultimately, success on the Connecticut will require a mix of innovative approaches as complex and intertwined as the vast river itself. While the study confirmed that it is not always easy or straightforward to lessen the impact of dams on the environment, our findings provide a firm foundation for productive dialogue and a deeper understanding of the great river—its history, its needs, and its many uses. Our work also acts as a template for other regions and watersheds seeking a sustainable way forward—a path toward a future where healthy ecosystems and human progress are not at odds with one another, but where nature and people can thrive together.



**For more information:**  
Katie Kennedy  
The Nature Conservancy  
136 West Street, Suite 5  
Northampton, MA 01060  
[kkennedy@tnc.org](mailto:kkennedy@tnc.org)  
413/586-2349

**Photos:** Cover: © Jerry & Marcy Monkman; Page 2: © Jerry & Marcy Monkman; Page 3: © Jerry & Marcy Monkman; Page 5, clockwise: © Steve Collins, © Jerry & Marcy Monkman, © Jerry & Marcy Monkman, © Robert B. Clontz/The Nature Conservancy, © Jerry & Marcy Monkman; Page 7: © USACE; Back, clockwise: © Jerry & Marcy Monkman; © Jerry & Marcy Monkman; © Jerry & Marcy Monkman; © Jane Pritchard

