The Value of Transient Mud

HOW TENNESSEE VALLEY MUDFLATS BENEFIT MIGRATORY BIRDS

By William G. Minser, Matthew J. Gray, John W. Laux, and Drew W. Wirwa

Stretching for 1,500 miles through seven southeastern states, the Tennessee River Valley watershed is dotted with 49 glittering reservoirs—havens for boaters, anglers, and others drawn by the solace of water. These reservoirs were formed as the Tennessee Valley Authority (TVA) built a massive system of dams throughout the Valley in the 1900s, inundating some 470,000 acres of riverine floodplains. This dam system provides recreation, flood control, hydroelectric power, and—as we've recently learned—vital stopover habitat for migratory shorebirds traveling through the Mississippi and Atlantic migratory bird flyways.

On a typical fall day, we observed more than 700 shorebirds foraging on nine mudflats along the Kentucky Reservoir in Tennessee, just south of the Kentucky line. If that count is representative of other mudflats along the reservoir, we estimate that approximately 20,000 to 28,000 shorebirds use this one reservoir each year during their fall migration (Wirwa 2009). That's a level of shorebird use sufficient to qualify Kentucky Reservoir as a "Site of Regional Importance" in the Western Hemisphere Shorebird Reserve Network (WHSRN 2010). Yet that's only a hint at the significance of the Valley's reservoir mudflats.

As researchers in the University of Tennessee's Wetlands Program, we wanted to learn about the importance of exposed mudflats as foraging and resting habitat for migrating waterbirds. After conducting two, two-year studies of three TVA reservoirs, we've learned that the transient mudflats—exposed as reservoirs begin to draw down in late summer—serve as critical refueling and resting stops for thousands of migratory shorebirds, waterfowl, and other bird species—findings with important implications for the management of the continent's wetland-dependent birds.

Coauthor Affiliations

Matthew J. Gray, Ph.D., is an Associate Professor of Wildlife Ecology in the Department of Forestry, Wildlife, and Fisheries at the University of Tennessee, Knoxville.

John W. Laux is a Wildlife Biologist with the Nebraska Game and Parks Commission.

Drew W. Wirwa is a Wildlife Refuge Specialist with the U.S. Fish and Wildlife Service's Southeast Louisiana Refuge Complex.

Mud's Ecological Role

Some of the roughly 50 species of shorebirds that occur in North America nest as far north as the Canadian arctic and travel more than 10,000 miles to winter in South America (Skagen and Knopf 1993). To maintain energy for that vast journey, shorebirds require stopover sites where they can rest and forage on aquatic invertebrates that live in exposed and shallowly flooded mudflats. In North America, several shorebird species—such as piping plovers (*Charadrius melodus*) and buff-breasted sandpipers (*Trymgites subruficollis*)—are in decline because the wetlands and mudflats on which they depend have been eliminated or degraded by agricultural and urban development and environmental contamination.

Credit: Ruxandra Guha

William G. Minser is an Instructor/Research Associate in the Department of Forestry, Wildlife, and Fisheries at the University of Tennessee-Knoxville.

Credit: Drew Wirwa

An aerial view of Kentucky Reservoir in Tennessee shows the emergence of mudflats as the Tennessee Valley Authority draws down water levels in the fall. For as many as 28,000 weary migratory shorebirds, the muddy turf of this reservoir provides welcome stopover habitat that's rich with invertebrates and other high-energy food needed to fuel migration.

The TVA manages water levels in its reservoirs to facilitate navigation, generate hydroelectric power, cool nuclear reactors, and control floods. To help achieve these goals, the TVA must generally draw down reservoir levels beginning in late summer or early fall, exposing an estimated 29,600 acres of mudflats (Smith 2006). Thus, one of the nation's largest dam builders is providing significant refueling habitat at a critical time for migrating shorebirds.

We had several questions about the role of these mudflats, however. We wondered to what extent they are used by waterbirds, especially declining shorebird species. Do the mudflats provide significant food resources for waterbirds, and how can TVA manage drawdowns to accommodate these wetland dependent species?

Credit: Matthew J. Gray

Graduate research assistant John Laux, right, counts distant birds as technician John Campbell records data during a fall waterbird survey on the mudflats of Chickamauga Reservoir in Tennessee. Exposed in late fall, this site benefits shorter-distance migrants such as killdeer, Wilson's snipes, and least sandpipers.

To find the answers, we studied three major TVA reservoirs in Tennessee—Douglas, Chickamauga, and Kentucky Reservoirs—to evaluate the value of exposed mudflats for waterbirds and to study impacts of the timing of reservoir drawdowns on waterbird use during fall migration. Under the guidance of Matthew Gray, John Laux studied Douglas and Chickamauga Reservoirs in 2005 and 2006 (Laux 2008), and Drew Wirwa studied Kentucky Reservoir in 2006 and 2007 (Wirwa 2009). We counted waterbirds on mudflats twice weekly from August to January over the two-year duration of each study. In addition, we sampled mudflats twice monthly for vegetation, seeds, aquatic invertebrates, and soil characteristics.

A Bountiful Buffet

Shorebird response to mudflat exposure was quick and dramatic. Birds zeroed in on TVA mudflats sometimes within only a few hours of drawdowns. In all, we observed a total of 76 species of waterbirds using mudflats on the three reservoirs we studied, including 26 species of shorebirds, 22 species of waterfowl, and 28 other waterbird species (Laux 2008, Wirwa 2009). Clearly these sites are providing important refueling and resting stops for thousands of shorebirds and waterfowl and dozens of other waterbird species such as gulls, egrets, and herons. Among our other findings:

- Shorebirds began using mudflats as early as July, when the flats first became exposed, and continued using them through January, with counts peaking in September.
- Species use varied by month. The greatest number of shorebird species occurred in August and September and primarily consisted of long-distance migrants such as pectoral (*Calidris melanotos*) and semipalmated (*Calidris pusilla*) sandpipers. Shorter-distance migrants and wintering species, such as the Wilson's snipe (*Gallinago delicata*) and killdeer (*Charadrius vociferous*), were more common from October to December.
- We documented two federally endangered species—piping plover on Kentucky Reservoir mudflats and a wood stork (*Mycteria americana*) in the shallow waters of Douglas Reservoir—both spotted in August. Some of the other species of management concern that we observed include American golden plover (*Pluvialis dominica*), buff-breasted sandpiper, and Wilson's phalarope (*Phalaropus tricolor*).
- Food resources were plentiful, with invertebrate density ranging from 3.3 to 8.8 million invertebrates per acre, and seed resources equivalent to 1,360 duck energy days per acre (Wirwa 2009).
- The shorebirds we observed spent 46 to 98 percent of their time feeding on these fuel-rich mudflats (Laux 2008, Wirwa 2009).

Although recently exposed mudflats represent a small proportion of the overall landscape along continental migration routes, waterbirds clearly

seek out these refueling sites and use them heavily. Based on our analyses and data from other studies (see Loesch *et al.* 2000), we estimate that nearly 450,000 shorebirds could be using TVA reservoir mudflats during fall migration (Wirwa 2009). Given that the entire Mississippi Alluvial Valley supports approximately 500,000 shorebirds annually (Loesch *et al.* 2000), our findings underscore that the well-used mudflats of the Tennessee River Valley are extremely valuable for continental shorebird populations.

Management Implications

The TVA has a large biological staff that works with company engineers to adjust reservoir management to benefit fish and wildlife conservation. As part of these efforts, the TVA—along with the U.S. Fish and Wildlife Service and the Tennessee Wildlife Resources Agency—provided funding for our research, designed in part to provide recommendations about the timing of drawdowns for the benefit of waterbirds.

We found that drawdowns in July and August benefited long-distance migrant shorebirds, including some species of conservation concern such as piping plovers. Drawdowns in September benefited the greatest diversity and numbers of shorebirds, while October and November drawdowns benefited waterfowl and short-distance migratory shorebirds such as killdeer and Wilson's snipe.

Based on these observations, we therefore recommend a sequential drawdown of reservoirs in the Tennessee River Valley, such that new mudflats are continuously exposed throughout the TVA Reservoir System from late July through November. When possible, drawdown rates should be slow (one centimeter per day) to prolong invertebrate availability on mudflats throughout migration (Laux 2008). This two-pronged approach would accommodate both early and late migratory waterbirds.

When the TVA dammed the free-flowing rivers of the Tennessee River Valley, many forms of aquatic and riparian habitat and species were lost or displaced. However, as TVA lowers water levels in the Valley's reservoirs each year, mudflats appear at an optimal time for fall bird migrations. While these muddy lake bottoms may be considered the homely byproducts of power generation and flood control, they provide critical stopover habitat for migrating shorebirds, waterfowl, and other waterbirds—diamonds in the rough for flight-weary migrants.