Shoreline buffers improve water quality
By Ole Hendrickson

Research aimed at maintaining water quality and a healthy agriculture sector may help inform future actions related to pollution issues in Muskrat Lake and the Muskrat River watershed.

One location with interesting lessons is Tifton, Georgia, a rural farming community in the southern U. S. In the 1960s, staff at the U.S. Department of Agriculture (USDA) Southeast Watershed Research Laboratory in Tifton installed a small dam with an automated water sampler on the Little River, part of the Suwanee River watershed, and began analyzing nitrogen and phosphorus on an ongoing basis.

They found that the Little River catchment had excellent water quality even though 80% of its area was devoted to intensive agriculture: corn, soybeans, peanuts, livestock, etc.

In the 1970s, USDA researchers and University of Georgia scientists teamed up to determine why fertilizer and livestock nutrients added to the watershed weren't ending up in the Little River. They proposed that "riparian" forests (forests lining the banks of the river) act as "nutrient filters".

To test this theory, Richard Lowrance, then a University of Georgia graduate student, met with local farmers and persuaded them to allow access to their land. He installed lines of shallow wells extending from the uplands down to the river. His data showed marked declines in nutrient levels as groundwater flowed from crop fields and pastures into the riparian forests. Other graduate students measured how vegetation and soil microorganisms in the forests were absorbing these nutrients.

When Lowrance and colleagues published a 1984 BioScience article (*Riparian forests as nutrient filters in agricultural watersheds*) they prompted many other scientists to study this topic.

A 2014 paper in the Journal of the American Water Resources Association (Sweeney and Newbold, *Streamside forest buffer width needed to protect stream water quality, habitat, and organisms*) draws upon research findings from the past three decades. These authors conclude that a 30-meter strip of vegetation is optimal for filtering sediments, nutrients, and pesticides from farming operations. In addition, this width of buffer – roughly equal to the height of mature streamside trees - provides shade and cooler water temperatures required for healthy fish and aquatic invertebrate communities.

In addition to maintaining fish habitat, forested buffers provide better nutrient filters than grass strips. A 2010 article in the Journal of Environmental Quality (Zhang and others, *Review of vegetated buffers and a meta-analysis of their mitigation efficacy in reducing nonpoint source pollution*) concludes that "Buffers composed of trees have higher N and P removal efficacy than buffers composed of grasses or mixtures of grasses and trees."

In rural Renfrew County, drainage schemes in the Muskrat River watershed have converted natural meandering streams to straightened, deepened, and widened channels. Native riparian vegetation has been eliminated, causing decreased bank stability and bank erosion. Intensive farming in the drained areas has increased phosphorus in soils of the stream banks. Large amounts of phosphorus enter the streams when banks erode.

This relationship between bank erosion and phosphorus loads is examined in detail in a 2012 article in the Journal of Environmental Quality (Kronvang and others, *Phosphorus load to surface water from bank erosion in a Danish lowland river basin*). The Danish researchers measured erosion by pushing 3000 narrow, 2-foot long steel pins into the river bank, perpendicular to the bank face, at a number of locations. They also measured phosphorus (P) in stream bank soils at these locations.

The Danish researchers found that bank erosion could account for as much as 53% of the phosphorus lost from diffuse sources in the catchment. They also found that “a large part of the exported P with suspended sediment from the catchment is or can be bioavailable when transported to downstream surface water systems,” and is therefore an “important… eutrophication driver in surface waters.” This suggests that phosphorus inputs from bank erosion may create the high nutrient, low oxygen conditions associated with algal blooms in downstream water bodies.

The Danish researchers suggested that bank erosion and phosphorus leaching into the waterway could be reduced by replacing intensive agricultural production along the river banks with forested riparian buffers. They found that “planting trees in buffer strips reduces bank erosion by as much as 25 to 40% compared to erosion rates from buffer strips planted with vegetation such as grass and herbs.”

Richard Lowrance, the lead author of the 1984 BioScience article, remains active as a scientist at the USDA watershed research facility in Tifton, Georgia. With Diane De Steven, he wrote a 2011 article in Ecological Applications (*Agricultural conservation practices and wetland ecosystem services*). It reviews practices that reduce soil erosion, protect water quality, and provide wildlife habitat in agricultural areas: conserving existing buffers, planting buffers where none exist, and restoring, creating, or managing wetland habitats.

Scientific research clearly supports the use of forested buffers to protect waterways such as those in the Muskrat River watershed from erosion and agricultural runoff.