Sedimentation

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Sedimentation is arguably the most important water-quality concern in the United States. Sediment trapping is cited frequently as a major function of riverine-forested wetlands, yet little is known about sedimentation rates at the landscape scale in relation to site parameters, including woody vegetation type, elevation, velocity, and hydraulic connection to the river. The Coosawhatchie River in coastal South Carolina, a blackwater stream, is compared to the Cache River on the Mississippi alluvial plain in Arkansas, a brownwater stream (Hupp and Schening 1997). Sedimentation rates along each river were estimated at sites along transects perpendicular to the channel by measuring the amount of deposition over the major root system of age-determined trees. These rates were related in turn to vegetation type, ground surface elevation relative to adjacent channel, hydroperiod, flow velocity, and hydraulic connection to river water. Additionally, short-term rates of deposition were estimated through the establishment of white, feldspar clay markers.

Mean deposition rates ranged from 0.02 to 0.20 cm per year on the Coosawhatchie site and from 0.20 to 0.36 cm per year on the Cache site. This result was expected because the brownwater Cache River carries an order-of-magnitude-greater suspended load—about 100 to 350 mg per liter—than the Coosawhatchie (about 5 to 25 mg per liter). Sedimentation patterns within both study areas varied strongly with elevation and thus vegetation patterns; sedimentation rates were greatest in sloughs and low elevations away from the main channel. Deposition varied inversely with velocity category on the Coosawhatchie site, while on the Cache site deposition varied directly (fig. 1.7). No sites along either stream experienced high velocities, which would have precluded most deposition of fine sediments. Low velocities facilitated deposition of fines, particularly organic material; however, relatively moderate velocities may have ensured a continuous supply of sediment-laden water available for deposition. On the Cache site, mild velocities may have increased mineral fines deposition whereas the lowest velocities may have had a poor connection to the river and were subject to stagnation.

Construction of white feldspar clay pad as a marker for determining short-term sedimentation rates.

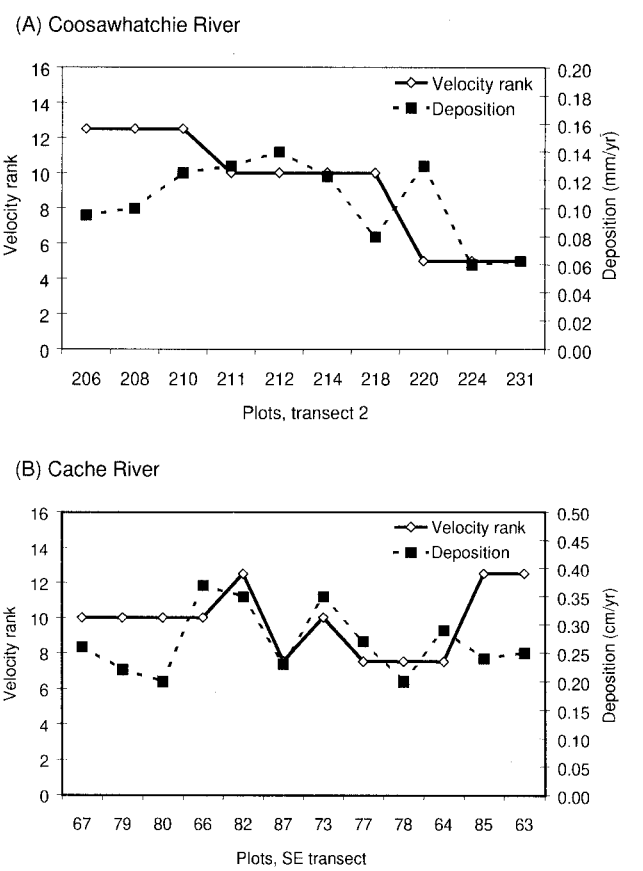

Figure 1.7—Deposition rates (dashed line) and velocity category rank (solid line, higher rank indicates higher velocity) along transect 2 of the (A) Coosawhatchie River and along the SE transect of the (B) Cache River.

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Hydraulic connectivity (degree of flow-path connections to the river) appeared to affect sedimentation rates on the Coosawhatchie site; greatest deposition occurs along sloughs with a direct flow path to the river (figs. 1.8, 1.9). A slough enters the Coosawhatchie study area upstream and away from the channel (top of fig. 1.9), bifurcates through the area, and reenters the main channel downstream. Sedimentation rates are highest in this slough (connected to the river upstream of study area). The most distal (away from river) end of transect 3, the central parts of transect 2, and the distal three sites on transect 1 are all affected (increased sedimentation) by this slough (fig. 1.10). Similar results could not be confirmed along the Cache River because high water has prevented sedimentation investigations along the central transect. Preliminary results from clay-pad analyses along the Coosawhatchie River suggest that sedimentation rates were generally greatest along tract 2 and near the river along all three transects (fig. 1.10). Hydraulic connectivity explained the increased deposition along transect 2 and the decreased deposition along transect 1, which is partially blocked by a road. Most clay pads west of the main forest road are largely separated from the river and have only trace amounts of deposition. Fines deposited over the clay pads contained substantial amounts of organic material, nearly 40 percent on the blackwater Coosawhatchie Bottomland Ecosystem Study area. This contrasts with 22 percent on the Cache River site. Subsequent decomposition and compaction may affect preliminary results of these highly organic deposits. Whether mineral fines and organic fines share the same deposition patterns is currently unknown.

Both streams annually trap substantial amounts of sediment, although deposition rates on the Cache site are twice those on the Coosawhatchie site. Soil chemistry investigations will allow estimation of the trapping of sediment-associated contaminants. Preliminary results suggested that sediment trapping patterns were most closely related to sediment supply, hydraulic connectivity to river water, and flow velocity. Additionally, vegetation patterns, largely controlled by hydroperiod, probably affected deposition rates though variation in surface roughness (stem size and density, coarse woody debris production) and thus the velocity of sediment-laden flows.

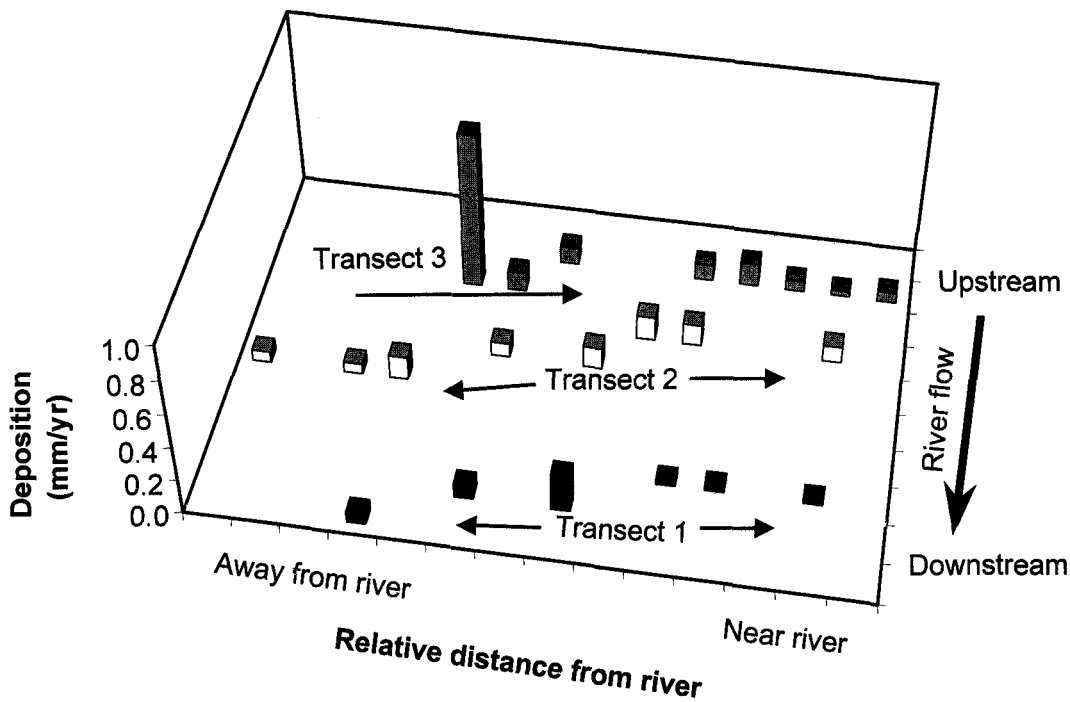

Figure 1.8—Sediment depostition along the three transects of the Coosawhatchie Bottomland Ecosystem Study site.

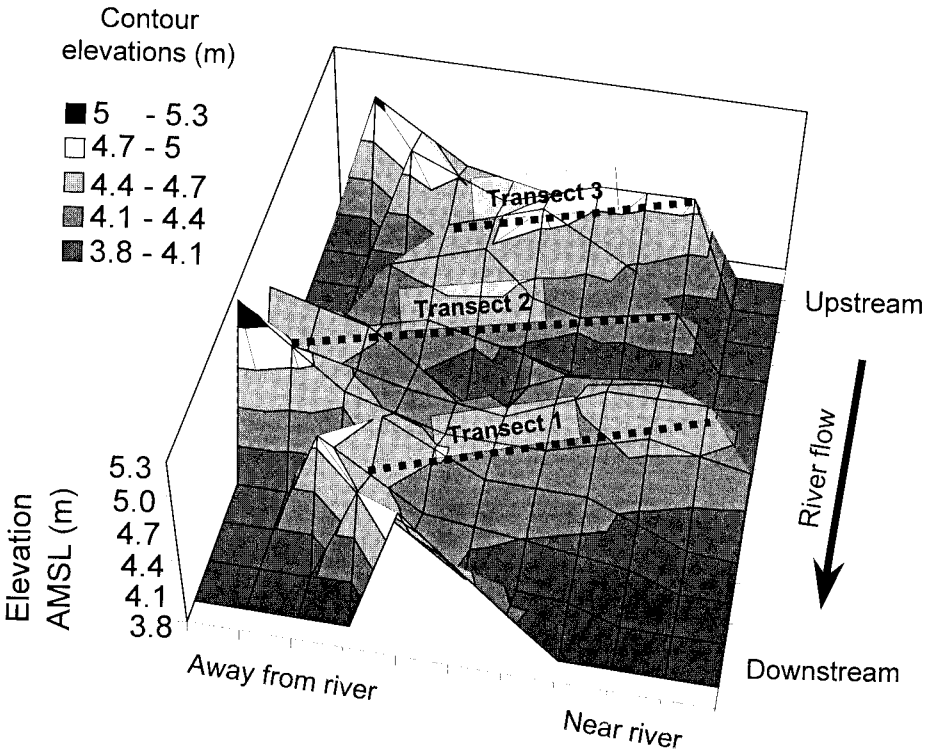

Figure 1.9—Grid point elevation on the Coosawhatchie Botomland Ecosystem Study site.

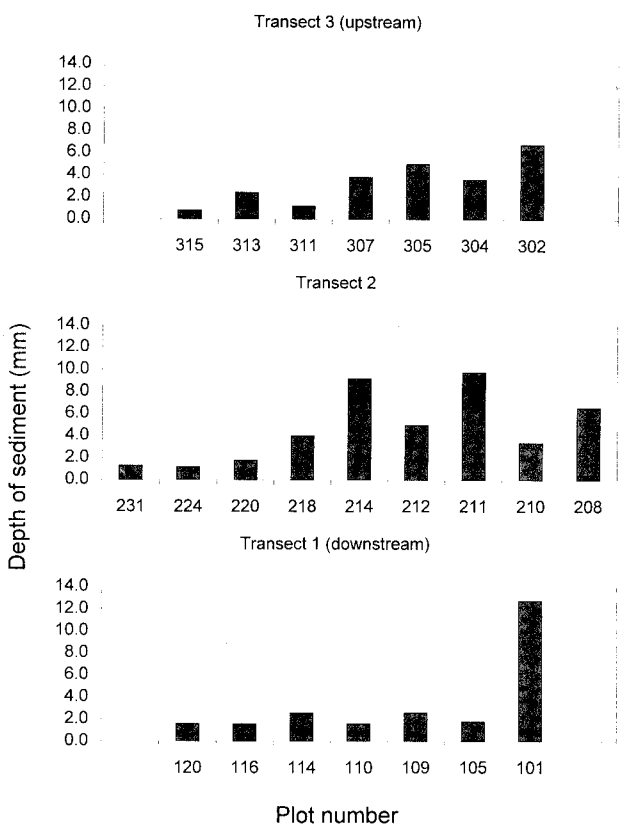

Figure 1.10—Short-term deposition above clay-pad markers (May 1996 to May 1997, preliminary data) along the three Coosawhatchie River transects.