Hydrology

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Hydrologic processes are the main determinants of the type of wetland located on a site. Precipitation, groundwater, or flooding interact with soil properties and geomorphic setting to yield a complex matrix of conditions that control groundwater flux, water storage and discharge, water chemistry, biotic productivity, biodiversity, and biogeochemical cycling. Hydroperiod affects many abiotic factors that in turn determine plant and animal species composition, biodiversity, primary and secondary productivity, accumulation of organic matter, and nutrient cycling. Because the hydrologic regime has a major influence on wetland functioning, understanding how hydrologic changes influence ecosystem processes is essential, especially in light of the pressures placed on remaining wetlands by society's demands for water resources and by potential global changes in climate.

The Coosawhatchie is a fourth-order, anastomosing, blackwater river with a drainage area of approximately 1000 km^2. The floodplain surface is approximately 1.6 km wide and the relief on the surface is about 2 m. A surficial aquifer at the study site is about 9 m thick and consists of alluvial sand and clay, deposited by the Coosawhatchie River, and older Pleistocene sand and clay. These deposits are underlain by a 12-m-thick confining unit, which in turn overlies the Floridan aquifer.

Surface-water stage data from two gauging stations upstream and one downstream from the study site were used to predict the historical duration of flooding and inundation across the study site. Hampton Branch Station is located approximately 24 km upstream; Early Branch Station is approximately 8 km upstream; and Grays Station is immediately downstream of the site. At the study site, the river generally crests 3 to 4 days after rain events, and crests at Grays are 2 to 3 days after those at Hampton (figs. 1.3, 1.4) (Cooney and others 1996).

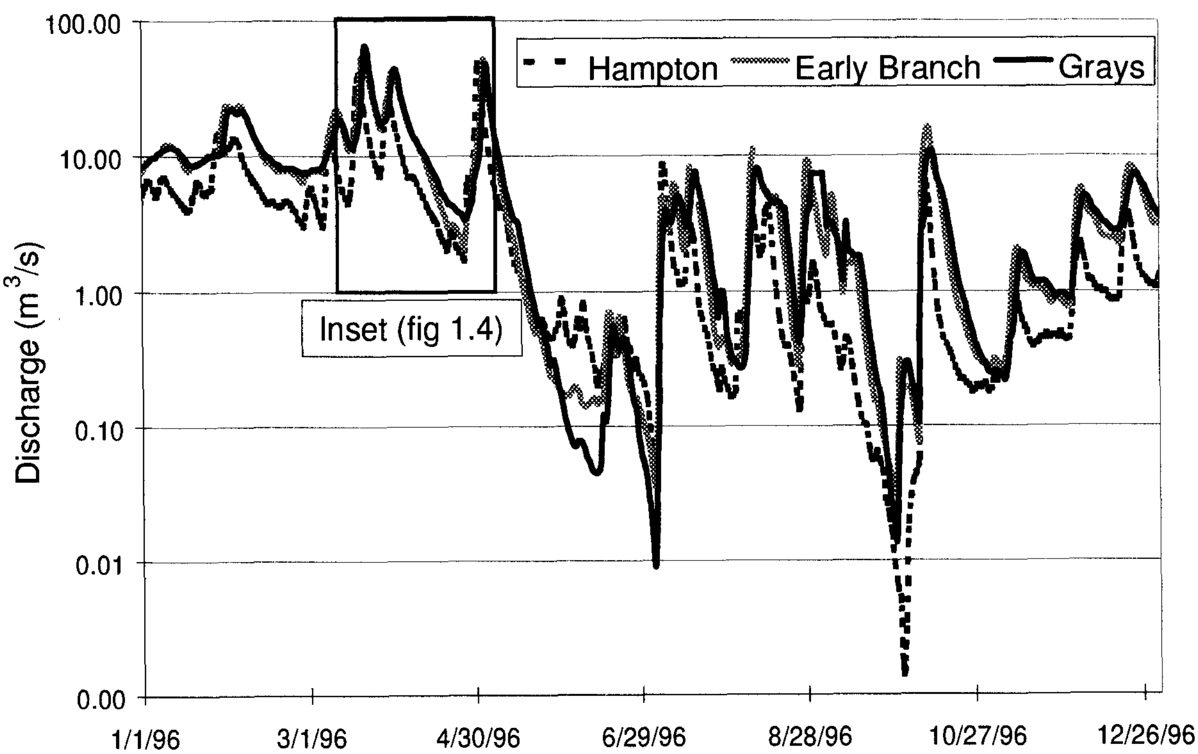

Figure 1.3—Discharge during 1996 for the three U.S. Geological Survey gauging stations located on the Coosawhatchie River (Cooney and others 1996).

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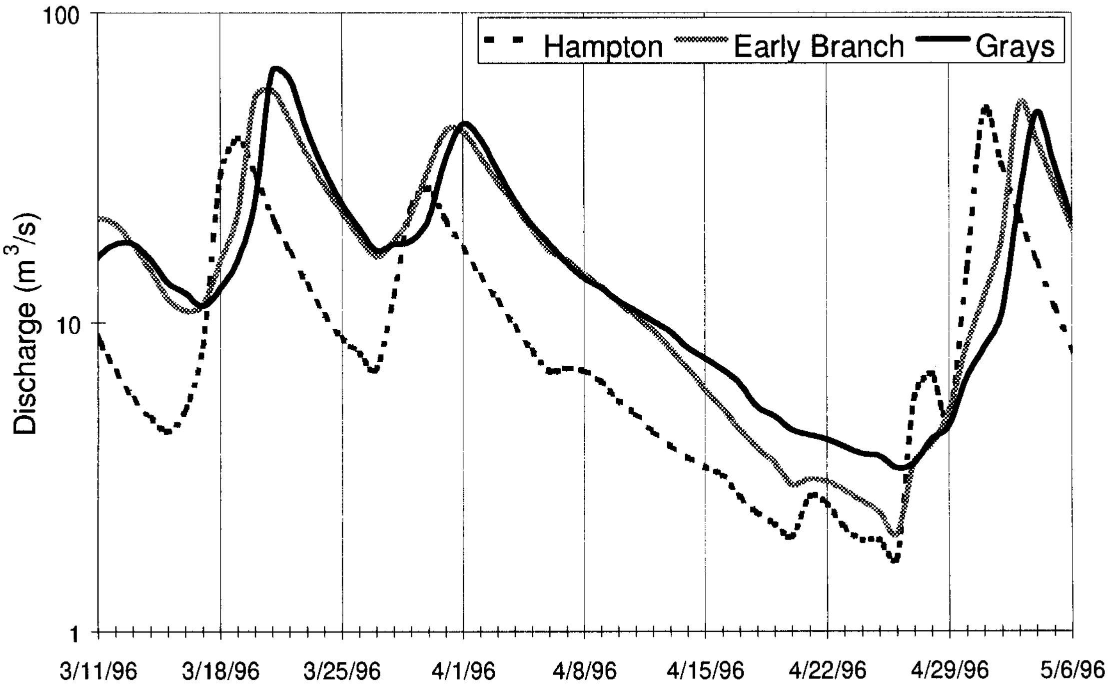


Figure 1.4—Stream response to storm events and lag between three U.S. Geological Survey gauging stations located on the Coosawhatchie River between March 11, 1996, and May 6, 1996 (Cooney and others).

Ground- and surface-water levels have been monitored since July 1996. Depth and duration of surface inundation and the elevation of the water table were used to examine the factors controlling hydrologic conditions across the site and the relationship between hydroperiod, plant community structure, and ecological processes. Wells and piezometers were installed in the surficial aquifer adjacent to and in the river channel at 22 locations (fig. 1.5) to monitor the elevation of the water table in association with the vegetation plots, and to determine the recharge-discharge relation between the ground water and surface water.

Regressions of water-table elevations on the floodplain at 18 polyvinyl chloride observation wells, using the river stage and 4 continuous recording wells as the independent variable, yielded correlation coefficients that ranged from 0.56 to 0.97. Water levels in wells closest to the river generally correlated best with river stage. The regression models predicted that the mixed oak (*Quercus* spp.), laurel oak (*Q. laurifolia* Michx.), swamp tupelo (*Nyssa sylvatica* var. *biflora* [Walt.] Sarg.), and water tupelo (*N. aquatica* L.) forest communities were inundated on average 0, 12, 39, and 52 percent of the year, respectively, and were saturated within 30 cm of the soil surface on average 24, 41, 77, and 88 percent, respectively, (fig. 1.6) during the October 1996 to September 1997 water year. Measurements of potentiometric surface indicated ground-water discharge is the dominant condition, but recharge can occur during extremely high flows.

The Floridan aquifer is about 21 m deep and currently has a potentiometric surface approximately 0.5 m above land surface at the study site. The potentiometric surface of the Floridan aquifer has declined approximately 5 m at the study site during the last century due to ground-water withdrawals for municipal and industrial water supplies (Hughes and others 1989). Historic decreases in ground- and surface-water flow at this site may have affected vegetation community dynamics, and may have resulted in long-term shifts from wetter to dryer species compositions. Only after the hydrologic functions and their influence on other ecosystems are determined, will it be possible to assess the potential influences of regional (aquifer drawdown) and global (climate) changes.

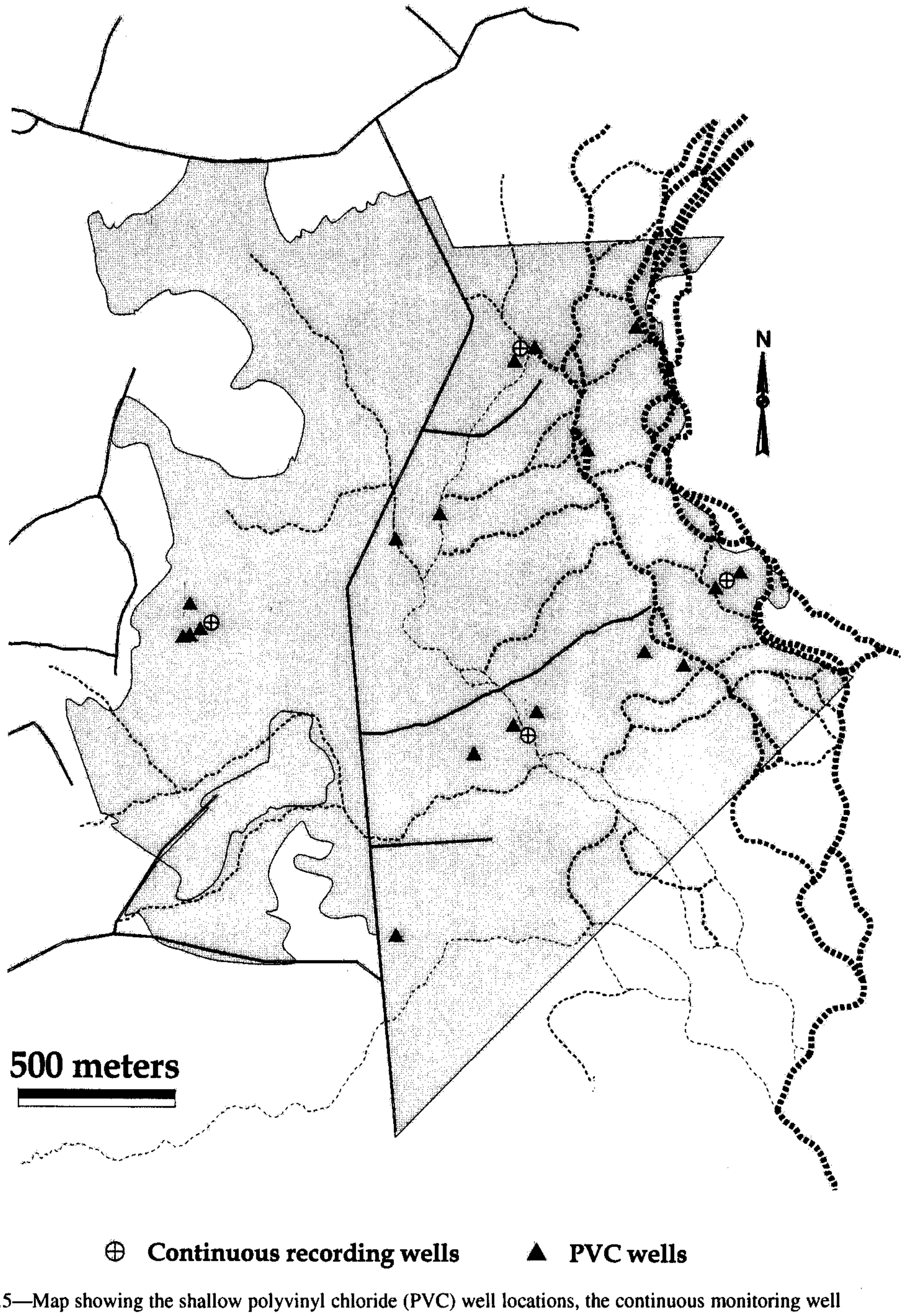


Figure 1.5—Map showing the shallow polyvinyl chloride (PVC) well locations, the continuous monitoring well locations, and the primary water-moving channels on the Coosawhatchie Bottomland Ecosystem Study site, South Carolina.

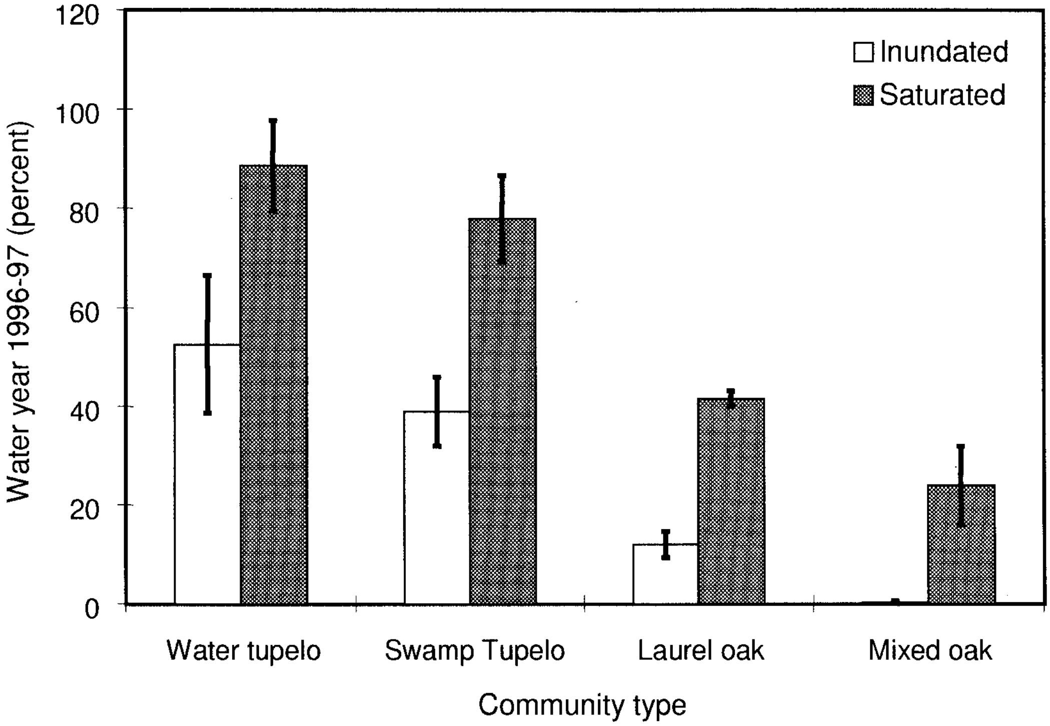
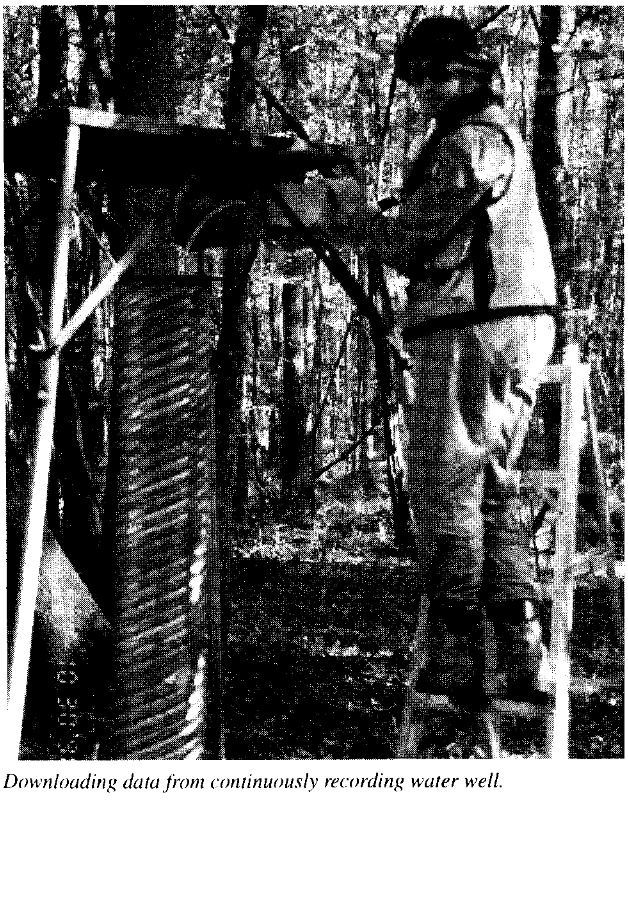


Figure 1.6—Duration (mean and standard error) of flooding (inundated) and saturation within 30 cm of the average soil surface elevation at the well for the 16 productivity plots located on the Coosawhatchie Bottomland Ecosystem Study site in water year 1996-97 (October through September).



Downloading data from continuously recording water well.