Hydrologic Interactions between Surface Water and Ground Water in Taylor Slough, Everglades National Park

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Determining the extent of hydrologic interactions between wetland surface water and ground water in Taylor Slough is important because the balance of freshwater flow in the lower part of the Slough is uncertain. Although freshwater flows through Taylor Slough are quite small in comparison to Shark Slough (the larger of the two major sloughs in Everglades National Park), flows through Taylor Slough are especially important to the ecology of estuarine mangrove embayments of northeastern Florida Bay. The extent of wetland and ground-water interactions also must also be known before their role in affecting water quality can be determined. Taylor Slough is separated from Shark Slough by a series of low-lying coastal ridges referred to as Long Pine Key, and by an area of relatively high-elevation wetlands called the Rocky Glades. Historically, Taylor Slough received water from precipitation, surface overflow from Shark Slough, and possibly as ground-water discharge from the coastal ridge systems. Presently, Taylor Slough receives much of its water from the L31-W canal at the S332 pumping structure (at what is effectively the northern terminus of Taylor Slough), and from outflow at the southern end of the L31-W canal (fig. 1).

Taylor Slough is underlain by organic wetland peat that varies in depth (0.2 – 2μ) and in the content of calcitic mud. Under the peat is a highly permeable sand and limestone aquifer (Biscayne aquifer). Two approaches were used to investigate wetland and ground-water interactions in Taylor Slough. One approach involved computing ground-water discharge using chloride as a tracer. Measured flows at pumping or release structures and estimates of precipitation, evapotranspiration, and surface-flow velocity were needed in addition to chloride measurements in surface water and in ground water. The second approach estimating ground-water discharge by combining estimates of hydraulic conductivity in the peat (determined by the piezometer slug test method) with measurements of vertical hydraulic gradient. Vertical discharge from the peat was computed from those data using Darcy's law.

The research was conducted during seven primary measurement periods between September 1997 and September 1999. Results are discussed with reference to four segments (referred to as reaches) that comprise Taylor Slough (fig. 1). The first reach is between structure S332 and Taylor Slough Bridge. A net loss of surface flow by recharge from Taylor Slough to ground water was evident in this reach. Evidence for recharge is based on the substantially lower surface flow measured at Taylor Slough Bridge compared to that measured at S332 structure. During some periods recharge accounted for as much as 80 percent of the pumped input from the S332 structure. In reach 2 (directly south of Taylor Slough Bridge) there was only minor dilution of chloride in surface water, suggesting that discharge of ground water with lower chloride concentration was minor in Taylor Slough. The slight decrease in chloride concentration with distance in reach 2 could usually be explained by accounting for precipitation and evapotranspiration. In reach 3 there was a significant decrease in chloride concentration that could not be explained by precipitation and evapotranspiration, suggesting a substantial discharge of ground water into Taylor Slough in reach 3, however, the chloride-dilution signature in reach 3 was present during all data collection periods in both wet and dry seasons (fig. 2). For example, a calculation for November 1997 indicated that ground-water discharge might have been as large as 3 cm/day in reach 3, or approximately an order of magnitude higher than evapotranspiration (fig. 3). The average observed chloride concentrations increased in reach 4, which cannot be explained by the simulations, because both the observed precipitation and evapotranspiration, and ground-water inflow would cause dilution of chloride. Chloride concentrations therefore appeared to be affected by tidal inputs of chloride from Florida Bay in reach 4, and cannot be estimated by the chloride balance method.

The source of discharging ground water detected by the chloride balance is chemically dilute ground water and surface water that enters the Slough from the western side. The ultimate source of that water is probably precipitation that recharges the aquifer on Long Pine Key. Surface-water inputs to Taylor Slough cannot be separated definitively from ground-water inflow on the western side of the Slough because both are relatively low in chloride concentration. It is assumed that much of that surface flow also had its origin as recharge on Long Pine Key, flowing to the southeast in the shallow ground-water system, discharging prior to reaching the measurement point at Ingraham Highway. Because of those complex interactions, all of the water entering from the western side of Taylor Slough that was delineated using chloride as a tracer identified as "shallow ground-water discharge."

In contrast, vertical discharge of ground water from directly beneath Taylor Slough cannot be detected by using chloride as a tracer. This is because of the similarity in chloride concentration between Taylor Slough surface water and ground water directly beneath the channel. The best estimate of ground-water discharge from directly beneath Taylor Slough was 0.06 cm/day, which represents a relatively minor component of inflow in comparison with shallow ground-water discharge from the west.

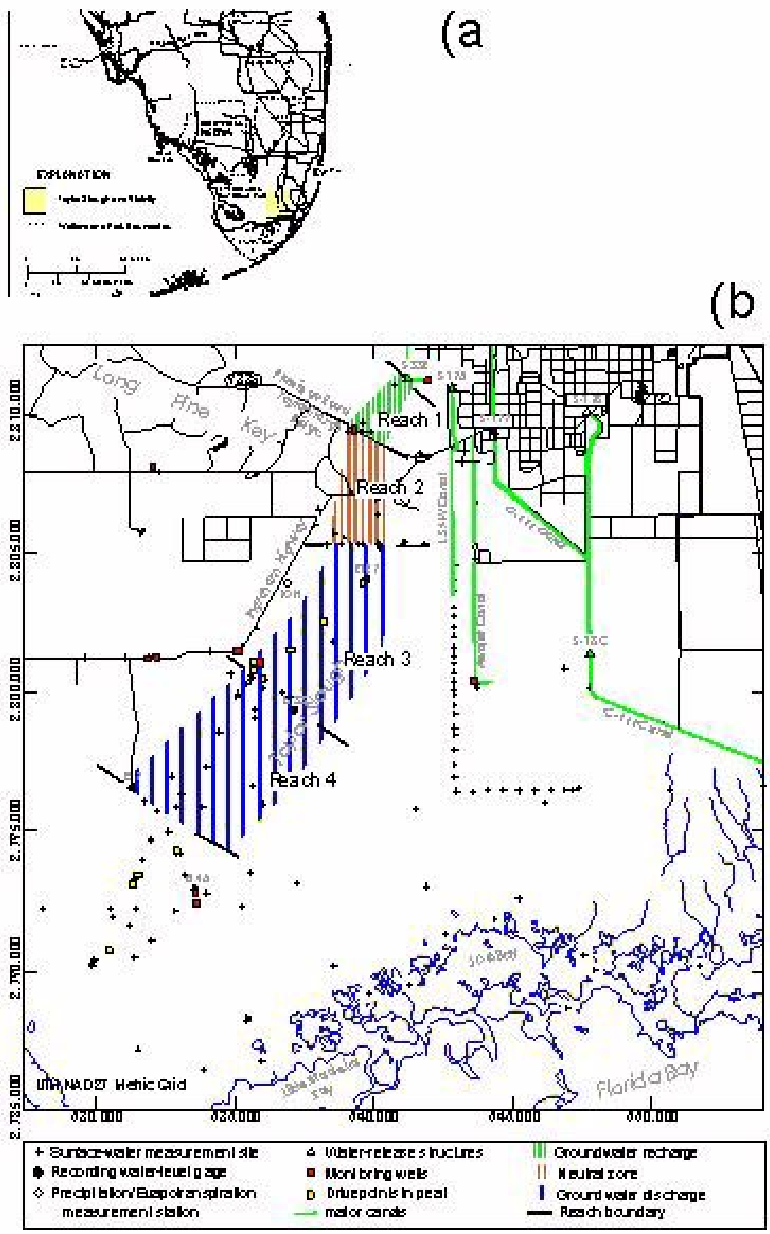

Figure 1. General location map (a) and (b) locations of measurements of recharge and discharge in Taylor Slough, Everglades National Park.

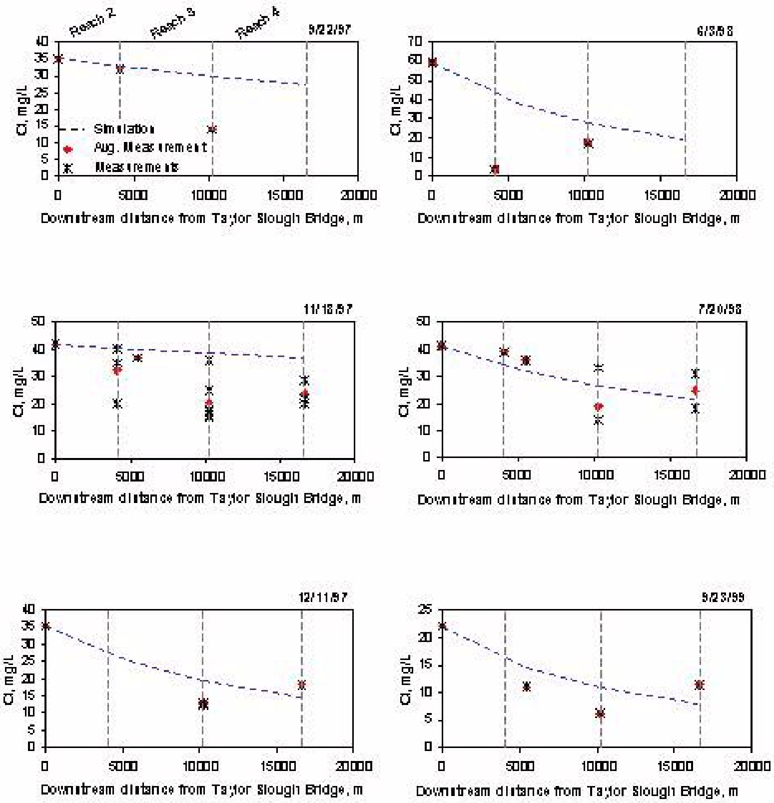

Figure 2. Comparison between observed and simulated chloride measurements in Taylor Slough surface water. The simulations considered only precipitation and evapotransportation without ground-water discharge or recharge.

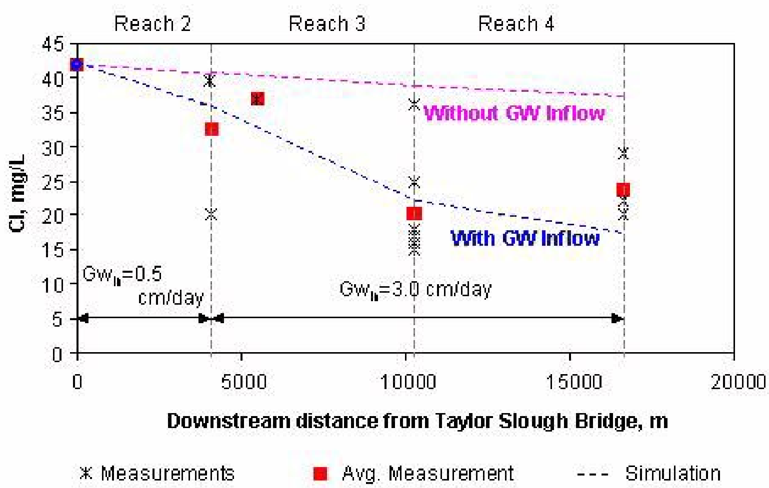

Figure 3. Calculated ground-water discharge for November 18, 1997 using flow velocity of 1.0 cm/sec.