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A decision support system for adaptive real-time management of seasonal wetlands in California

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Abstract

This paper describes the development of a comprehensive flow and salinity monitoring system and application of a decision support system (DSS) to improve management of seasonal wetlands in the San Joaquin Valley of California. The Environmental Protection Agency regulates salinity discharges from non-point sources to the San Joaquin River using a procedure known as the total maximum daily load (TMDL) to allocate the assimilative capacity of the river for salt among watershed sources. Management of wetland sources of salt load will require the development of monitoring systems, more integrative management strategies and coordination with other entities. To obtain local cooperation, the Grassland Water District (GWD), whose primary function is to supply surface water to private duck clubs and manage wetlands, needs to communicate to local landowners the likely impacts of salinity regulation on the long-term health and function of wildfowl habitat. The project described in this paper will also provide this information. The models that form the backbone of the DSS, develop salinity balances at both a regional and local scale. The regional scale concentrates on deliveries to and exports from the GWD while the local scale focuses on an individual wetland unit where more intensive monitoring is being conducted. The design of the DSS is constrained to meet the needs of busy wetland managers and is being designed from the bottom up utilizing tools and procedures familiar to these individuals.

Keywords: Wetlands; Salinity; Real-time monitoring; Assimilative capacity

1. Introduction

The Grassland Water District (GWD) together with the adjacent State and Federal refuges constitute the largest contiguous wetland in the State of California (Fig. 1). The GWD comprises two interconnected units—the northern and southern GWD units—which together provides water to more than 20,000 ha of privately owned wetlands, mostly used as over-wintering habitat for wildfowl on the Pacific Flyway. The Northern GWD (NGWD) is larger in area than the Southern GWD and contains discrete drainage outlets, which provide drainage to distinct subbasins within the NGWD (Fig. 2). For this reason, the NGWD was chosen as the subject of the study described in this paper.

Seasonal wetlands in the GWD are flooded in the fall and drawn-down in the spring to provide habitat for migratory waterfowl, shorebirds, and other wetland-dependent species. Due to alterations in natural hydrology, these wetlands are flooded with Central Valley Project water supplies delivered through GWD canals. In the spring, during the months of March–April, seasonal wetlands are drawn-down to mimic the natural dry cycle of a seasonal wetland. Wetland drawdowns are timed to make seed and invertebrate resources available during peak waterfowl and shorebird migrations and to correspond with optimal germination conditions (primarily soil temperature) to grow naturally occurring moist-soil plants. The seeds of moist-soil plants are recognized as a critical waterfowl food source, providing essential nutrients and energy for wintering and migrating birds (Fredrickson and Taylor, 1982). Optimal timing of wetland flood-up and release has been determined by trial and error for different species of moist-soil plants and for different environmental conditions, although guidelines for these practices are poorly documented.

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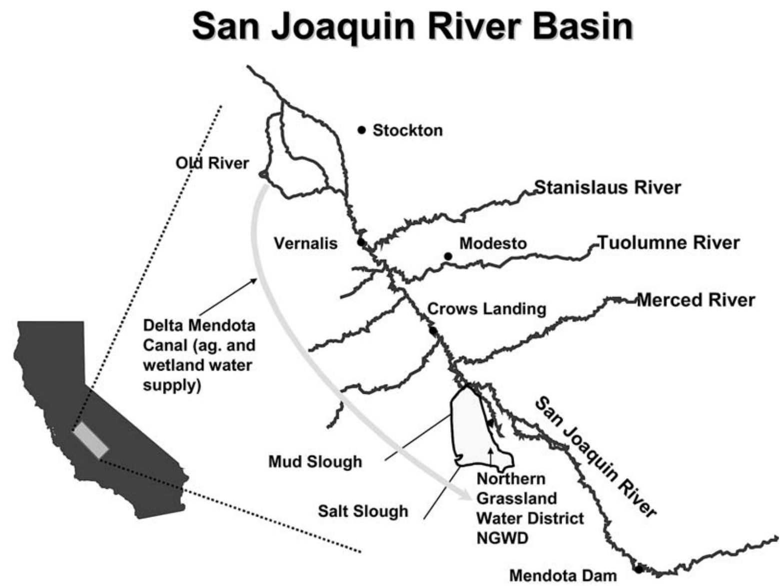

Fig. 1. SJR Basin showing NGWD and the major west-side wetland drainage conveyances Mud and Salt Sloughs. Water supply to agriculture and wetlands in the Grassland subbasin is provided through pumping from the Sacramento—San Joaquin Delta via the Delta Mendota Canal.

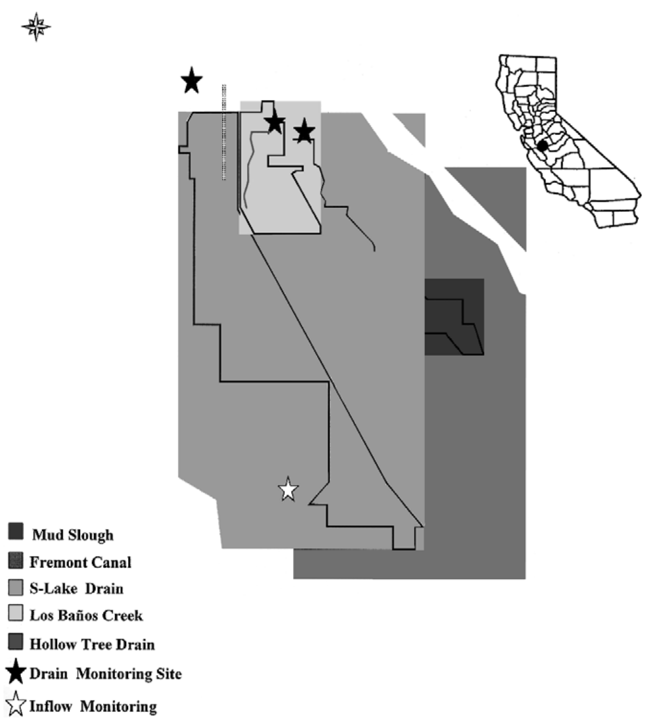

Fig. 2. NGWD showing drainage subbasins and both inflow and drainage monitoring.

2. Wetland management

The seasonal wetlands of the GWD are managed to meet habitat requirements by flooding in the fall and releasing their waters in the spring. Spring releases are discharged into tributaries of the Lower San Joaquin River (SJR). These releases, in combination with agricultural drainage that flows through the GWD, contain varying amounts of total dissolved solids (TDS), boron, and selenium. These constituents have been identified as stressors that lead to frequent exceedance of water quality objectives established for the SJR by state and federal agencies.

Research conducted by Grober et al. (1995) suggests that wetland drainage from the GWD could be scheduled to coincide with peak assimilative capacity in the SJR to help improve downstream water quality (Fig. 3). Assimilative capacity in the SJR occurs during periods when the average electrical conductivity (EC) at Vernalis is below the seasonal running average concentration. Fig. 3 shows that the irrigation season EC objective of 700 uS/cm between April 15 and August 15 each year is frequently violated. Between 1985 and 1998 the EC objective at Vernalis was violated more than 70% of the time.

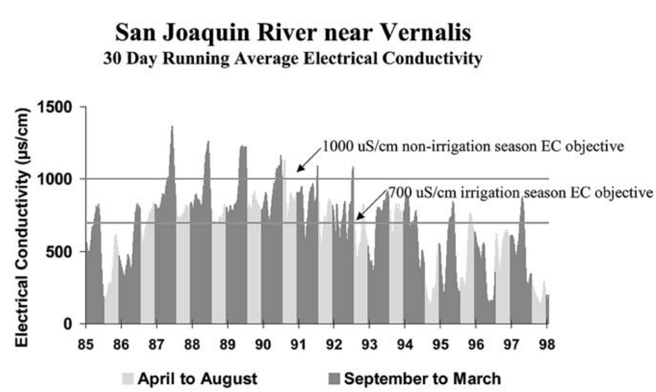

Fig. 3. SJR 30-day running average EC showing periods of assimilative capacity (graph below seasonal objective) and violation (graph above seasonal objective). Over the past 13 years, salinity (EC) objectives have been violated approximately 70% of the time.