Impacts of Delayed Drawdown on Aquatic Biota and Water Quality in Seasonally Managed Wetlands of the Grasslands Ecological Area

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Compliance with water quality objectives may be improved by timing wetland drawdown to coincide with periods of high San Joaquin River assimilative capacity for salt. This project investigated some of the impacts of a delayed wetland drawdown on algae biomass and on water quality of seasonal wetland drainage. Delayed wetland drawdown is one of a number of management options for coordinating west-side San Joaquin Basin drainage salt loads with east-side reservoir releases that generate much of the River's assimilative capacity for salt. Experimental results of the current study show that algal biomass in the water column is most likely controlled by grazing zooplankton concentrations since no nutrient, insolation, or carbon limitations were observed. Algae concentrations dramatically increase during drawdown of wetlands due to the scouring of periphyton. Total and soluble nutrient concentrations were found to be low throughout the season. Nutrient concentrations increased during drawdown due to disturbance of nutrient rich sediments. Specific conductivity values rose in most wetlands throughout the season due to combined emergent plant evapotranspiration and direct pond evaporation. 79% of the VSS loading and 39% of the TDS load export occurred during drawdown Turbidity had a strong correlation with volatile suspended solids concentrations. This correlation was seen in all wetland paired sites.

The 178,000-acre Grassland Ecological Area in California's San Joaquin Valley is managed to provide overwintering habitat to waterfowl on the Pacific Flyway. The major management activity is the fall flooding and spring drawdown of wetlands, timed to optimize the availability of forage vegetation and invertebrates for ducks and shorebirds.

Wetland drainage contains salt, boron, and trace elements that are largely derived from imported surface water but concentrate during storage in the wetland impoundments and contribute to occasional water quality violations in the San Joaquin River (SJR) during dry years. Compliance with water quality objectives may be improved by timing wetland drawdown to coincide with high SJR salt assimilative capacity during mid-March to mid-April when reservoir releases are increased to aid salmon migration.

The experimental sites chosen were three pairs of matched wetland basins (20-100 acres each) that are part of the larger Modified Hydrology Study. For each wetland pair, one was managed with a traditional March drawdown; while the drawdown was delayed up to one month for the other to coincide with the period of high SJR assimilative capacity. Two additional drainage sites were added to the second year of sampling to better characterize drainage flowing to the SJR. Soil and water column

samples were collected during the flooded periods at the inlets, outlets, and along transects within the wetlands. Water quality analyses included total/volatile sus-pended solids, conductivity, nitrogen (NH4+, NO2-+NO3-, organic), phosphorus (total, $PO4^{3-}$), total organic carbon, alkalinity, turbidity, temperature, and pH. Planktonic and benthic invertebrates were identified and enumerated.

Data were collected between February and April, 2007 and 2008. Identified phytoplankton were predominantly chlorophytes and diatoms. Zooplankton that feed on phytoplankton were found in abundance and consisted mostly of Daphinia. Benthic invertebrates were also assessed to help explain the differences in algal concentrations between ponds. Benthic invertebrates were found to be predominantly Chironomidae.

Seasonal loads of volatile suspended solids, total dissolved solids, and total organic carbon were estimated at the 2 drainage sites and at one modified hydraulic regime wetlands during the 2008 season. For volatile suspended solids the load was 1481 lbs, 2506 lbs, and 769 lbs respectively. For total dissolved solids the load was 553 lbs, 988lbs, and 49 lbs respectively.

Of the factors potentially limiting phytoplankton concentrations, invertebrate grazing was likely the most important. Nutrients were not limiting in either the traditional or modified wetlands, as indicated by sufficient N and P of the algae. Likewise, inorganic C was not limiting, as indicated by pH (most <9.0 pH). Sunlight intensity was not significantly attenuated by water depth or turbidity.

Total and soluble nutrient concentrations were low throughout the season. These levels increased during drawdown due to the scouring of nutrient rich sediments.

Specific conductivity values rose in most wetlands throughout the season due to moist soil plant evapotranspiration and direct pond evaporation. This was most noticeable in the Ducky Strike which were the shallowest of the wetland ponds surveyed.

Related Publications

Quinn N.W.T, 2009. Environmental decision support system development for seasonal wetland salt management in a river basin subjected to water quality regulation. Agricultural Water Management, 96 (2), p.247-254, Feb 2009.

Collaborative Efforts

This project is part of a collaborative interagency effort to study water quality and ecological impacts of delayed drawdown in the Grassland Ecological Area. Contributors to our research include John Beam, Bill Cook, Lara Sparks, Ric Ortega and Charlotte Peters from the California Department of Fish and Game, John Eadie from UC Davis, and Laura Castro and Ernie Taylor from the California Department of Water Resources.

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