Ecohydrologic Effects of Stream Restoration

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Stream restoration activities throughout California are numerous; however the hydrologic and vegetation responses of these restored systems are poorly understood and rarely documented. The goal of this research is to quantify the hydrologic and ecologic effects of a "pond and plug" stream restoration of a meadow system, in order to improve future design efforts.

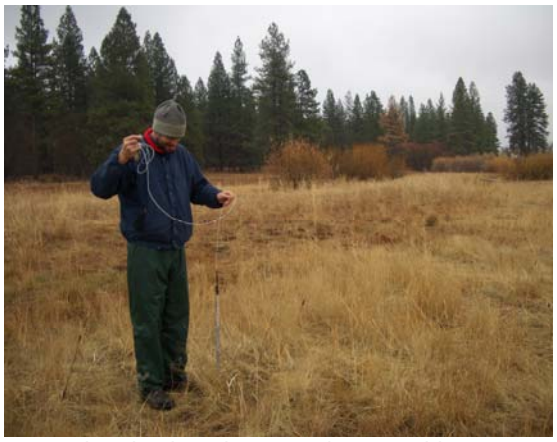
Rivers and streams, and their dependent floodplain ecosystems have experienced dramatic degradation throughout California, and much of the world. The growing appreciation of the functions and services that riverine-floodplain wetlands provide and a realization of the need to rehabilitate these degraded systems has lead to a blossoming industry of stream restoration. While stream restoration activities are plentiful, sound scientific basis for various actions, protocols for design, and post-project monitoring and assessment are generally lacking. Specifically, the effects of the popular "pond and plug" channel restoration method upon river-floodplain hydrology and wetland vegetation remain poorly documented. Given the proliferation of these projects, an improved under-standing of the ecohydrologic effects of stream manipulation is vital in improving the methods used to design and assess them.

Through post-project monitoring and assessment, in combination with numerical modeling of an exceptionally well-documented "pond and plug" stream restoration project, this research seeks quantitative answers to two fundamental questions. First, what is the hydrologic response of surface water and groundwater to stream restoration? Second, how will these hydrologic changes impact the distribution of native wetland plant species? This research is focused on a 2.2 mile restored meadow reach of Bear Creek, the largest ephemeral tributary to the Fall River, Shasta County, California. The research plan involves two linked programs, hydrology and vegetation response.

To quantify the impact of the "pond and plug" stream restoration activities on various components of the meadow's hydrology, a hydrologic model of the restored meadow has been constructed, and is currently undergoing calibration. This numerical model consists of a two-dimensional hydraulic model to simulate inundation of the meadow surface coupled with a three-dimensional subsurface model to simulate

Monitoring streamflow

the complex temporal and spatial movement of groundwater throughout the meadow. Atmospheric exchanges due to precipitation and evapotranspiration are also included within the hydrologic model. The first year of UC Center for Water Resources funding allowed for the development/construction of the numerical hydrologic model, in addition to various crucial data collection activities which included, stream flow and water table elevation monitoring, geochemical boundary condition characterization and the refinement of the post-project digital elevation model. During the second year of UCWRC funding, the calibrated and validated hydrologic model will be used to simulate and compare the stream-meadow hydrology under pre- and post-restoration topographic conditions. Expected results include simulation of changes to the: outflow hydrograph (flood peak reduction and delay), depth to groundwater, extent of inundation, floodplain and subsurface storage, as well as evapotranspiration. Preliminary modeling results suggested a significant change to each of these hydrologic components, due to the restoration.



Measuring depth to the ground water table.

The restoration of this reach of Bear Creek caused significant changes to inundation of the meadow surface and depth to groundwater through much of the meadow. These hydrologic changes drove changes in the distribution of wetland plants. In the summer of 2005, data documenting the diversity and abundance of herbaceous vegetation within 185 plots distributed throughout the restored meadow was collected. This vegetation data has been analyzed and several communities (wet meadow, moist meadow, dry meadow, and vernal pool) identified. A predictive vegetation model statistically linking these identified plant communities to the temporal trends in inundation and availability of shallow groundwater is under development. Once complete, this model will be used in combination with the hydrologic model to simulate the areal extent of various vegetation communities present under pre- and post-restoration hydrologic conditions. Expected results include an increase in the distribution of wet and moist meadow communities and a reduction of the dry meadow community type, in addition to an increase in the habitat available for species specializing in vernally wet environments.

The results of this study will aid in many elements of similar stream restoration activities. The integrated ecohydrologic methods utilized will benefit land managers, restoration practitioners and regulators by establishing baseline information regarding the potential benefits of similar projects, as well as developing a new predictive tool to assess potential design considerations. As stream restoration projects increase, and the need to balance the multitude of demands on the precious water resources within the state continues to grow, a better understanding of the hydrologic and ecologic effects of such restoration activities is crucial.

Collaborative Efforts

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