



Temporal and Spatial Linkages Between Watershed Land Use and Wetland Vegetation Response, Elkhorn Slough, Monterey County, CA

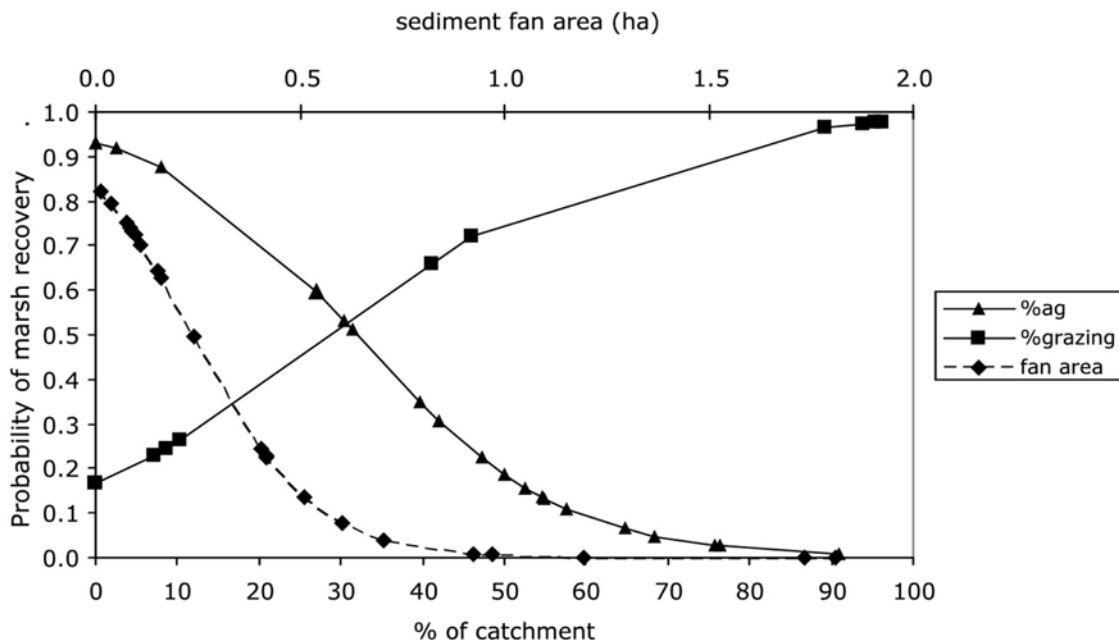
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Elkhorn Slough supports one of California's largest coastal marshes, which is protected as an ecological reserve. More than three decades of upstream farming in a watershed characterized by steep topography and sandy soils have produced significant sedimentation, which has formed sandy fans in the salt marsh. As these fans have grown, salt marsh vegetation has converted to riparian willows. Salt marsh recovery depended on the type of land use in individual catchments, with more grazing and less farmland leading to better chances of recovery.

Elkhorn Slough supports one of the largest coastal marshes in California and contains a NOAA estuarine research reserve and other protected lands. Agriculture, specifically strawberry farming, has increased dramatically in the watershed since 1970. This land use change has led to sedimentation in the slough and the growth of sediment fans in the salt marsh over several decades. The goal of this project was to determine how watershed land use change over

30 years influenced changes in salt marsh soil physical/chemical properties, and in turn, plant composition through the use of remote sensing, GIS and field methods.

Historical aerial photo change detection revealed a shift in wetland species in response to sedimentation. Sedimentation caused arroyo willow (*Salix lasiolepis*) encroachment into pickleweed-dominated (*Salicornia*



Probability of salt marsh recovery from sedimentation according to 1980 land use and sediment fan size, based on fitted logistic regression models. Sediment fan area is on the top X-axis and percent land cover in on the bottom X-axis.

virginica) salt marsh on 11 sediment fans, with willow gain of 4.75 ha and salt marsh loss of 2.34 ha. A multiple-decadal analysis provided information about transitional stages of plant community succession

Changes in salt marsh properties were investigated in the field to explain vegetation zonation patterns of arroyo willow, cattail (*Typha* spp.), and pickleweed on sediment fans. Fan development increased elevation at least 2/3 meter above the marsh plain and increased topographic variability. Deposition of sandy sediment led to higher elevation, higher soil bulk density, lower salinity, lower soil moisture, and lower soil nitrogen, compared to reference sites.

The high sand content of the transported sediment likely influenced changes in these soil properties. Willow expansion was limited by environmental thresholds, which included elevation of at least 1.8 meters NAVD88 where tidal influence existed, spring soil moisture less than 20% and salinity less than 3 dS/m year-round. Overall, increased sedimentation within a watershed defined by highly erodible sandy soils and steep topography led to a shift in the type of wetland that could be supported downhill of agriculture.

Present-day sediment fan size was explained by historical catchment landscape and land cover characteristics in multiple regression models, with large catchment characteristics (>10 ha) being stronger predictors of fan size ($R^2 = 0.96$). Salt marsh recovery potential increased with more grazing and less farmland. Results indicate a time-lag between land use change, sedimentation and wetland vegetation response. Results indicate a time-lag between land use

Considerable efforts have been made by the Elkhorn Slough Foundation, the Natural Resources Conservation Service, the Monterey County Resource Conservation District, and other organizations to reduce soil erosion in the Elkhorn Slough watershed and improve wetland habitat. Findings from this study emphasize the importance of continuing efforts by these groups to estuarine conservation in central California.

Publications

Byrd, Kristin B., N. Maggi Kelly, and Eric Van Dyke, Decadal changes in a Pacific estuary: a multi-source remote sensing approach for historical ecology, *GIScience and Remote Sensing* 41(4):347-370, 2004.

Byrd, Kristin B., Temporal and Spatial Linkages between Watershed Land Use and Wetland Vegetation Response in the Elkhorn Slough Watershed, Monterey, County, California. Ph.D. Dissertation, 173 pp, 2005.

Professional Presentation

Byrd, K.B. and N.M. Kelly, The relationship between watershed land use change, wetland soil physical properties and plant succession in a California coastal estuary, Proceedings of the 89th Annual Ecological Society of America Meeting, Portland, OR, August 1 – 6, 2004.

Collaborative Efforts

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