Remote-Sensing Techniques for Assessing Impacts of Wetland Real-Time Water Quality Management on Wetland Seasonal Habitat

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RESEARCH OBJECTIVES

The U.S. Bureau of Reclamation has recently announced its intention to require wetlands in the western U.S. to develop best management practices (BMP's). The formulation of BMP's requires detailed knowledge of current practices, together with accurate water balances and estimates of evapotranspiration, to allow assessment of water-use efficiency. The Bureau of Reclamation has entered into a collaboration with Berkeley Lab to develop remote - sensing tools to improve estimates of evapotranspiration and to assess habitat value based on quantitative estimates of moist soil plants. Recent advances in available image data and processing techniques have increased the scope for success in discriminating between moist soil plants found in managed wetlands in California's Central Valley. Models such as SEBAL and METRIC use thermal infrared data, in combination with visible and near-infrared data, to estimate evapotranspiration. Vegetation mapping can help extrapolate these estimates to the entire wetland resource area. This study explored the development of an accurate, consistent, and efficient methodology for mapping land cover and vegetation through remote-sensing technology.

APPROACH

Multispectral satellite imagery was used to map vegetation and other land cover in Central Valley wetlands. The imagery displayed reflected light in blue, green, red, and near-infrared wavelengths. High-resolution image data enabled mapping of small and irregularly shaped vegetation communities. An integrated GPS/field computer permitted rapid collection of consistent ground-truth data. The protocol for describing vegetation communities was based on the California Native Plant Society's Rapid Assessment Protocol, and a comprehensive field guide was developed for identification of plant species. Image data were processed using the software packages ERDAS Imagine and Definiens eCognition. Spectral signatures were developed using field data to guide the selection of representative pixels. A maximum likelihood algorithm was used to classify each pixel according to its statistical similarity to defined classes.

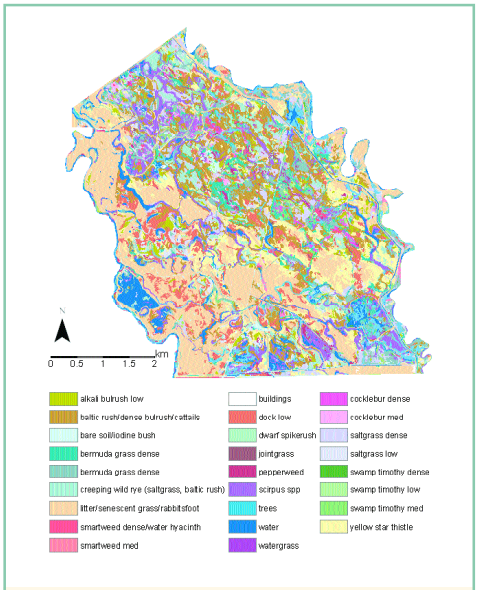

Figure 1. Map of land-cover classes derived from satellite image data using statistically based image processing. Image classification is an efficient process, using a few thousand known pixels to classify an entire image comprised of tens of millions of pixels.

ACCOMPLISHMENTS

A land-cover map was produced for an area of Central Valley wetlands covering 160 km^2. Figure 1 shows a map of land-cover classes represented in the San Luis National Wildlife Refuge. Most important vegetation communities, including those dominated by alkali bulrush, baltic rush, cocklebur, and swamp timothy, were represented with greater than 75% accuracy. Other classes, such as bermuda grass, smartweed, and watergrass, were classified with lesser accuracy. Overall, the remote-sensing methodology mapped a large area, using minimal field data, with a high degree of accuracy.

SIGNIFICANCE OF FINDINGS

Central Valley wetlands are significant water users and compete with agriculture for an adequate water supply. Effluent impacts water quality in the San Joaquin River, and real-time management of drainage may be incorporated into BMP's for these wetlands. Management decisions regarding water should be evaluated with respect to habitat health. A remote-sensing mapping methodology can provide an accurate and consistent means to track changes in habitat. Accurate land-cover maps also provide the basis for water-needs analyses through quantitative assessment of evapotranspiration from open water, bare soil, and vegetation communities.

RELATED PUBLICATION

Quinn, N.W.T, W.M. Hanna, J.S.Hanlon, J.R. Burns, C.M. Taylor, D. Marciochi, S. Lower, V. Woodruff, D. Wright, and T. Poole, Real-time water quality management in the grassland water district. Berkeley Lab Report LBNL-56825, 2004.

ACKNOWLEDGMENTS

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