

Preparer Information

PrepName_1A Margaret E. Andrew
PrepEmail_1B meandrew@ucdavis.edu
PrepPhone_1C (530) 752-5092

Project Information

ProjectNo_2C R/SF-10 StartDate_3a 9/1/2005 EndDate_3b 8/31/2008
ProjectTitle_4 Determining the Factors Controlling Site Invasibility to (I)Lepidium latifolium(I)
.....
.....

CALFed Fellow contact information

FelTitle_5A Ms FelLast_5B Andrew FelFirst_5C Margaret FelInit_5D E.
FelInstitution_5E University of California Davis
FelDepartment_5F Land, Air, and Water Resources
FelStreetAddr_5G One Shields Ave., The Barn
FelCity_5H Davis FelState_5I CA FelZip_5J 95616-8527
FelPhone_5K (530) 752-5092 FelFax_5L (530) 754-6353
FelEmail_5M meandrew@ucdavis.edu
FelPositionTitle_5N Graduate Student Researcher

Research Mentor (for additional please see #8)

RMTTitle_6A Dr RMLastName_6B Ustin RMFirstName_6C Susan RMInit_6D L.
RMInstitution_6E University of California Davis
RMDepartment_6F Land, Air, and Water Resources
RMStreetAddr_6G One Shields Ave., The Barn
RMCity_6H Davis RMState_6I CA RMZip_6J 95616-8527
RMPhone_6K (530) 752-0621 RMFax_6L (530) 752-5262
RMEEmail_6M slustin@ucdavis.edu
RMPositionTitle_6N Professor

Community Mentor (for additional please see #9)

CMTTitle_7A Mr CMLastName_7B Schoenig CMFirstNamt_7C Steve CMInit_7D
CMInstitution_7E California Department of Food and Agriculture
CMDDepartment_7F Integrated Pest Control
CMStreetAddr_7G 1220 N St.
CMCity_7H Sacramento CMState_7I CA CMZip_7J 95814-5607

Suisun Marsh and the Greater Jepson Prairie Ecosystem on the northwest side of the Delta. These successes demonstrate that it is possible to detect (I)Lepidium(I) with hyperspectral remote sensing data, at least at the local scale. Additional work to map this species at the Cosumnes River Preserve in the northeast Delta, however, has not been successful. Comparisons of the image data and of the classifier behavior at these three sites illustrate that mapping success depends not only on the traits of the species to be mapped, but also on the characteristics of the habitat it invades. This conclusion is novel and this work is being prepared for submission to the journal (I)Remote Sensing of Environment(I). The maps generated for Rush Ranch and Jepson are being used by the Solano Land Trust to develop weed management plans at these sites.

Much work has also gone into developing a general, regional-scale algorithm to detect (I)Lepidium(I) in image data of the entire Delta. This has not been successful. (I)Lepidium(I) is a small, sparse-canopied herbaceous species with only subtle spectral differences from co-occurring vegetation that is very difficult to map. At the local scale, confounding and intra-specific variation is minimized and powerful image processing techniques exist, enabling successful detection (as at Rush Ranch and Jepson). At the regional scale of the entire Delta, however, strong variation both reduces spectral distinctness and restricts analysis to more rudimentary, less sensitive algorithms. It has thus been impossible to separate (I)Lepidium(I) from other sparse, weedy species with spectral data at this scale. Future research in the Delta will be limited to strategically chosen focal sites.

Hyperspectral image data of the Delta in June 2007 has been acquired and a field campaign to ground truth this data has been conducted within five focal sites distributed throughout the Delta. This field data will be used to train and validate maps generated from the 2007 imagery and is much more detailed than would be possible if field data were collected throughout the entire Delta. The field data alone provides a good, although not comprehensive, record of (I)Lepidium(I) infestations.

PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and how they were resolved. Describe any ancillary research topics developed.

Modifications_12

The goal to map (I)Lepidium(I) over the entire Delta has been abandoned. Extensive confounding and intra-specific variation over large areas prevents the hyperspectral detection of this species, as described in the Progress Summary above. Further research will be limited to strategically chosen focal sites. Five sites have been selected which are well distributed across the Delta. These include a site in the north Delta (along Jefferson and River Rds.), three sites in the central Delta (Bethel Island, Bouldin Island, Sevenmile Slough), and a site in the south Delta (Paradise Cut). Each of these sites is extensively invaded by (I)Lepidium(I) and, collectively, they encompass a range of environmental and land-use conditions. It will be possible to apply the methods developed for Rush Ranch and Jepson at these sites and success is anticipated.

Lidar data of the Delta and Suisun Marsh has been acquired by the Department of Water Resources. Lidar provides very detailed, fine-resolution information about topography as well as vegetation structure. We are requesting this data from the agency, and will use it in the development of habitat suitability models.

A side project is being planned to use hyperspectral and lidar remote sensing data to investigate the effects of weather and microtopography on (I)Lepidium(I) phenology at Cosumnes River Preserve.

BENEFITS AND APPLICATIONS: Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see <http://science.calwater.ca.gov/pdf/soemgmtcues.pdf>).

BenefitsApplic_13

Management of invasive species can be improved with comprehensive maps of their distribution.

i (I)Lepidium latifolium(I) is a problem weed invading California's Bay-Delta.

i Hyperspectral remote sensing offers the potential to map invasive weeds.

i (I)Lepidium(I) has successfully been mapped with hyperspectral image data of several ecological preserves in the Bay-Delta (Rush Ranch Open Space Preserve, Jepson Prairie Preserve, Eastern Wilcox Ranch, Calhoun Cut Ecological Reserve, and Barker Slough), and these infestation maps are being used by the Solano Land Trust to develop weed management plans at Rush Ranch, Eastern Wilcox Ranch, and Jepson Prairie Preserve.

i This research is increasing regional awareness of (I)Lepidium(I). New coordination with Delta Wetlands, the organization that manages the heavily invaded focal site Bouldin Island, has alerted them to the noxious weed status of (I)Lepidium(I), and may result in the implementation of management measures.

PUBLICATIONS: List any publications, presentations, or posters that have resulted from this funded research. Give as many details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

Publications_14

Andrew, M.E. and S.L. Ustin (2007). The role of environmental context in mapping *Lepidium latifolium* with hyperspectral image data. (In preparation for Remote Sensing of Environment).

Andrew, M.E. and S.L. Ustin (2007). The role of environmental context in mapping *Lepidium latifolium* with hyperspectral image data. Poster presented at 8th Biennial State of the San Francisco Estuary Conference. October 16-18, 2005. Oakland, CA, USA.

Andrew, M.E. and S.L. Ustin (2007). The role of environmental context in mapping *Lepidium latifolium* with hyperspectral image data. Contributed talk at 92nd Annual Meeting of the Ecological Society of America, August 5-10, 2007. San Jose, CA.

Andrew, M.E. and S.L. Ustin (2007). Hyperspectral detection of *Lepidium latifolium* at canopy, local, and regional scales. Contributed talk at AVIRIS Science Workshop, Jet Propulsion Laboratory. May 30-June 1, 2007. Pasadena, CA.

Hestir, E. L., S. Khanna, M. E. Andrew, M. J. Santos, J. H. Viers, J. A. Greenberg, S. S. Rajapakse, and S. L. Ustin (2007). Identification of invasive vegetation using hyperspectral remote sensing in the California Delta ecosystem. Remote Sensing of Environment (Accepted).

Andrew, M.E. and S.L. Ustin (2006). Spectral and physiological uniqueness of perennial pepperweed (*Lepidium latifolium*). Weed Science 54:1051-1062.

Andrew, M.E. and S.L. Ustin (2006). Mapping perennial pepperweed with hyperspectral imagery of the Sacramento-San Joaquin Delta. Poster presented at 4th Biennial CALFED Bay-Delta Program Science Conference. October 23-25, 2006. Sacramento, CA, USA.

Andrew, M.E., and S.L. Ustin (2005). Spectral and physiological uniqueness of *Lepidium latifolium*. Poster presented at 7th

Biennial State of the San Francisco Estuary Conference... October 4-6, 2005... Oakland, CA, USA.

A large rectangular area with horizontal dotted lines for writing, spanning most of the page width and height.

COOPERATING ORGANIZATIONS: List those agencies and/or persons who provided financial, technical or other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz_15

California Department of Boating and Waterways ñ a grant from CDBW provides imagery of the Delta.
California Department of Food and Agriculture ñ provides boats and crews for fieldwork in the Delta, also the agency of my community mentors, Robert Leavitt and Steve Schoenig.
Solano Land Trust ñ collaborating to map Lepidium and other invasive weeds on SLT lands in the Bay Delta.
Cosumnes River Preserve and Information Center for the Environment ñ Collaborating with Dr. Joshua Viers to map Lepidium at the CRP. CRP has provided GIS data of Lepidium inventories on the preserve.

AWARDS: List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards_16

NA

KEYWORDS: List keywords that will be useful in indexing your project.

Keywords_17

Geographic Information Systems (GIS); HyMap; hyperspectral; invasibility; Lepidium latifolium; perennial pepperweed; remote sensing.

PATENTS: List any patents associated with your project.

