Sea Grant California

Modeling Wetland Plant Cover to Assess Ecosystems and Bird Habitats

Iryna Dronova, Former Delta Science Fellow

BACKGROUND

Wetlands are known to provide critical ecosystem services with significant economic value, yet they are also vulnerable to damage from stressors like climate change, human activities and invasive species.

However, wetlands have been underrepresented in studies linking ecosystem services and risks to indicators in vegetation canopies, and they are typically too unique to generalize predictions from existing studies. Important research is ongoing to understand the unique role of the CA Bay-Delta vegetation in carbon cycles, greenhouse gases and climate change.

Currently, Bay-Delta research occurs on a site-by-site basis. Linking canopy cover and canopy leaf area index (LAI, green leaf area per ground area) to satellite imagery could allow for these new data to be extrapolated across all areas of the delta and over time, thanks to 30 years of historical satellite imagery.

Additionally, prior research suggests that canopy cover and LAI show a strong relationship to ecosystem productivity, foliar nutrient content, physical site characteristics, bird habitat suitability, and spectral indices of plant greenness and photosynthesis. However, these relationships are not well known in wetlands to date.

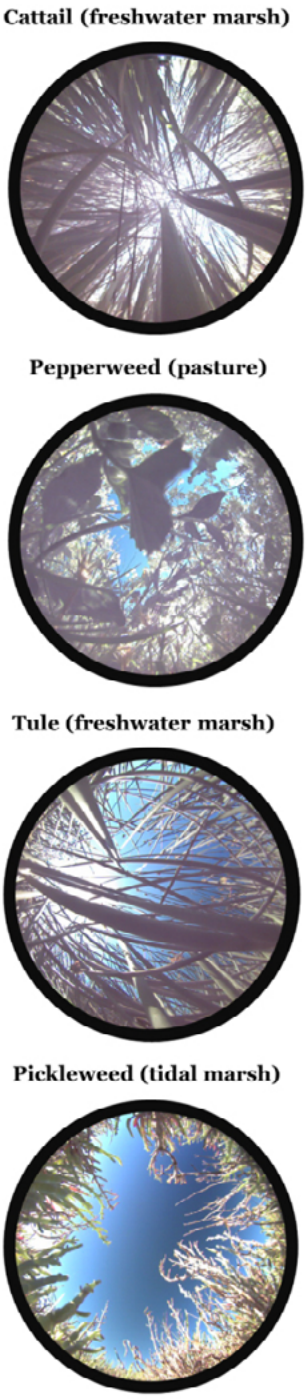
PROJECT

The Fellow will perform the first ever analysis of historical and present-day variation in canopy cover and LAI in the Delta wetlands by using field measurements, a 30-year archive of satellite image data, and geo-statistical spatial modeling.

By matching field measurements with current satellite imagery, the Fellow can then use statistical modeling to extrapolate LAI across the study area and over a predicted 30-year history.

The historic projection can then be compared to changes in land use, the range of wetland-dependent birds, and restoration efforts.

Iryna Dronova takes photos of freshwater marsh plants on Sherman Island. *PHOTO: UC Berkeley*



The photos of different types of plant communities in the delta, *right*, were taken with a spherical fish-eye lens that is pointed skyward from beneath the plant canopy. The images are used to calculate the canopy's leaf area index. *IMAGES: I. Dronova*

Iryna prepares to take hemispherical fish-eye images with a CI-110 Plant Canopy Imager in a tall reed canopy. *Courtesy photo*

MANAGEMENT APPLICATIONS

The fellow hopes to conclude by creating LAI and satellite data-based indicators that can be used to assess historical trends, current changes and future management efforts in the Bay-Delta. Since a number of Bay-Delta bird species are sensitive to canopy cover, the results may immediately serve as a reliable, low impact method of monitoring habitat suitability in restored or managed waterfowl habitat. Finally, the study will also provide a foundation for other researchers to utilize remote sensing in their studies, perform ecosystem modeling of carbon cycling and greenhouse gas fluxes, and predict site-based results over all areas of the Bay-Delta.

PROGRESS

The Fellow has collected two years of field measurements of LAI and canopy cover in wide a range of Bay-Delta habitat types including tidal and diked marshes, restored freshwater marshes of different stages, and even a rice paddy – an agricultural wetland. Field work revealed that the accumulation of dead biomass in wetlands has a significant effect on canopy cover.

There appears to be strong associations between field measurements and satellite indices of greenness. However, the Fellow has discovered that calibration between field and satellite data must be performed at high resolution to account for the high levels of heterogeneity in wetland structure and greenness that occur within a small scale. This work will be ongoing until the accuracy is sufficient to model spatial and historic variation.

PRESENTATIONS & POSTERS

Dronova, I. (2014) Strategies and challenges of assessing wetland canopy properties with field and remote sensing approaches: the case of California Delta, USA, Joint Aquatic Sciences Meeting, Portland, Ore.

Dronova, I. (2013) Wetland canopy leaf area index in the California Sacramento-San Joaquin Delta, USA: linking field measurements with canopy spectral properties and satellite imagery. American Geophysical Union Annual Meeting, San Francisco, Calif.

Dronova, I. (2013) Measuring Wetland Canopy Leaf Area Index from Hemispherical Photography: First Results in the Delta and Strategies for Spatial Interpolation. State of the Estuary Conference, Oakland, Calif.

Two guest lectures at UC Berkeley labs in the Department of Environmental Sciences, Policy and Management

RESEARCH MENTOR

Peng Gong, Environmental Science, Policy and Management, University of California-Berkeley

COMMUNITY MENTOR

Kristin Byrd, U.S. Geological Survey, Menlo Park, CA

CONTACT

Iryna Dronova, Ph.D.
Assistant Professor of Landscape Architecture & Environmental Planning, UC Berkeley
(former Postdoctoral Researcher)
510-642-2930
idronova@berkeley.edu

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