Use of UAVs in the Design, Construction Observation and Post-Project Monitoring of Salmonid Rehabilitation Projects

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The accessibility of unmanned aerial vehicles (UAVs or Drones) to the general public has grown in recent years, and with it has the opportunity to apply these relatively inexpensive, yet sophisticated devices in natural resource management. One application is the use of UAVs to collect low altitude aerial imagery for river rehabilitation projects. The aerial images can be used: to develop site maps and topographic data; to inform hydraulic modeling and design; to track progress on land and within aquatic areas, and to perform post-project physical and biological monitoring. To demonstrate the potential for this type of technology, a recently designed and constructed salmonid rehabilitation project consisting of gravel augmentation and side channel creation within the Nimbus Basin, along the Lower American River in Fair Oaks, CA was used. Aerial imagery was collected before, during and after construction. Imagery was used to develop topographic datasets and digital elevations models (DEMs) that were geo-referenced using RTK-GPS surveyed points. The DEM, as modified with additional bathymetric survey data, was used for hydraulic modeling to inform the rehabilitation design. During construction, the site was monitored regularly with the UAV to ensure proper construction techniques were being implemented as well as track overall progress. The site was surveyed after construction to document the as-built topographic conditions. In addition, post-project imagery was used to document the utilization of the constructed site by spawning salmonids.

Keywords: Aerial Surveying, UAV, Digital Elevation Model, Design, Rehabilitation, Monitoring

Poster Topic: Integrative Applied Science

SacPAS: Demonstration of a Real-time Decision Support System to Predict and Assess Operational Benefits and Risks to Central Valley Salmon.

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Problem statement: The volume of cold water available in the Central Valley is insufficient to protect all early life stages of temperature-sensitive Chinook salmon. Prior to the spawning season, Reclamation develops a water release schedule based on the weather forecasts. Currently, the forecasts and schedules are difficult to update over the fish spawning and rearing seasons and there are limited analytical tools and models to assess the impacts of their water schedules on fish survival and distribution.

Approach: The work, funded by Reclamation and in collaboration the Columbia Basin Research group at the University of Washington, is developing a decision support system that links a real-time data management system with models to forecast the progress and movement of salmon from spawning through smolt migration. Our immediate focus has been on winter-run Chinook salmon, but already there are applications which will be useful across multiple CVP-operated rivers. The web-accessible system has advanced through rapid prototyping and extensive interagency interaction to configure a system operating for Columbia River Salmon for over a decade.

Results: In its first year, the project has established a website (http://www.cbr.washington.edu/sacramento/) with extensive operational queries and alert functions and models to predict egg emergence and smolt migration. In 2016, the website tracked Sacramento Valley flood weir overtopping during the spring. Also, the website was used to look at spring temperature modeling and potential impacts to winter-run Chinook salmon and results were compared to inform decision making on summer temperature management planning. Finally, temperature analyses on CVP tributaries provides real-time exceedance results. These types of results will be demonstrated at this poster to illustrate the utility of SacPAS for linking data and science to in-season management.

Keywords: egg emergence, smolt migration, decision making, temperature, real-time forecast

Poster Topic: Integrative Applied Science

A Comparison of Two Sampling Gear Types in Liberty Island

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Sampling juvenile fish in tidal wetlands is difficult because no single technique can effectively sample all habitats. In 2016, seine sites in Liberty Island were sampled using a beach seine and lampara net to examine differences in fish CPUE, lengths, and community composition. No differences in CPUE were detected, however fish lengths differed between the two gear types and the lampara net caught more species of fish. This data will inform decisions on which method to recommend for sampling littoral tidal wetlands.

Keywords: Seine Lampara, Fish Sampling Methods Techniques, Littoral

Poster Topic: Integrative Applied Science

Potential GHG Emissions Reductions on Agricultural Lands in the Sacramento-San Joaquin Delta

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Recent development of the Methodology for Quantifying Greenhouse Gas (GHG) Emissions Reductions through Wetland Implementation and Rice Cultivation in the Sacramento-San Joaquin Delta allows for participation in the carbon market. It is the latest chapter in the evolution of strategies for subsidence mitigation and reduction of GHG emissions. In the late 1980s and early 1990s, CO2 flux measurements and subsidence measurement on farmed soils and demonstration of a net carbon gain associated with permanently flooded wetlands led to the creation of a subsidence-mitigation wetland in 1997. Since 1997, extensive data and modeling demonstrates the GHG benefits of conversion of agricultural lands to wetlands and rice and led to conversion of over 1,000 ha to wetlands. The primary benefit results from stopping or greatly reducing the documented ongoing emissions of up to 20 tons CO2 ha^{1} yr^{1}. Preliminary data indicate an additional 5 to 10 tons CO2-equivalents ha^{-1} yr^{-1} as N2O emissions. Baseline emissions were not considered in a recent USGS article and press release which warned about the potential lack of GHG benefit associated with Delta wetlands based on data from a single 3-ha wetland.

For a 300 ha wetland on Twitchell Island constructed in 2013, we used data, models and Methodology accounting procedures to estimate the annual benefit at about 8,000 tons CO2e. Moreover, for 3,700-ha Staten Island we assessed the GHG and economic consequences for agricultural mosaics that included rice and wetlands. Conversion to large areas of rice and wetlands resulted in near GHG neutrality to a net GHG sink for the island and small changes in farm income. Wetlands and rice also provide water fowl habitat and greater sustainability. Available data point to best management practices for maximizing wetland GHG benefit and minimizing aqueous carbon exports.

Keywords: Greenhouse gases, subsidence, wetlands

Poster Topic: Integrative Applied Science

The Delta Research Station: A Glimpse at the Future Hub for Monitoring and Research in the Bay-Delta

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The Delta Research Station (DRS) is a proposed science and research center to be located at the former Army Reserve Center in Rio Vista, California. The DRS will transform this idle site on the banks of the Sacramento River into a vibrant research facility and help reinvigorate an historic Delta city. The DRS will consist of two facilities: an Estuarine Research Station (ERS) and a Fish Technology Center (FTC). The ERS will be home to the Interagency Ecological Program (IEP). The ERS will provide additional and improved facilities for the IEP and bring together State and Federal agency staff working on common Bay-Delta issues. This increased coordination will provide interagency efficiencies and collaborative benefits. The ERS will include office and laboratory space, a marina for research vessels, and shop and maintenance facilities. The FTC will be an aquaculture facility that focuses on developing and testing captive propagation technologies for the Bay-Delta's rare fish species.

Keywords: Delta Research Station, Interagency Ecological Program Rio Vista

Poster Topic: Integrative Applied Science

Raising the Bar and Dropping the Cost of Aerial Imagery for Monitoring and Assessment

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Remote sensing of wetlands (and other landscapes) is an established assessment approach for resource management, protection, and restoration. Resolution, spectral bands, seasonality, and water levels are key imaging specifications. Traditional strategies utilize costly needs-tailored new flights, or buying moderately-priced commercial stock imagery (or free Google Earth) that is hit-or-miss in meeting needs. SF Bay National Estuarine Research Reserve is assessing the efficacy of Terravion's low cost imagery, which provides georectified natural color, color infrared, Normalized Difference Vegetation Index (NDVI), and thermal images. In summer 2016, we flew 13 wetlands covering ~8,000 acres around San Pablo and Suisun bays. We examined data acquisition effort, ease of GIS integration, time to image availability, and information yield relative to cost and traditional imagery. Terravion costs were <5% that of traditional air photo acquisition. Resolution was 20-30cm and Terravion is introducing 10-cm resolution imagery in fall 2016. Compared to traditional products, image color balance and contrast could be improved, which can be addressed with image processing. GeoTIFF imagery is generally available one day after acquisition. The multispectral imagery products greatly improve image analysis capabilities and thus data outputs. New imagery coordination is streamlined. Users upload KML or shape files, minor coordination follows, automated emails announce image availability, data is easily shared, and the Terravion portal provides data management/storage capability and analytical tools. The Terravion platform is a breakthrough: it can support remote sensing monitoring at large scale and with higher frequency at a small fraction of the cost than has ever been possible, opening wide the door to improved quality and highly cost-effective site-scale and regional wetland monitoring.

Keywords: Remote Sensing, Terravion platform, cost-effective, regional wetland monitoring

Poster Topic: Integrative Applied Science