NASA Ames DEVELOP interns collaborate with the South Bay Salt Pond Restoration Project to monitor and study restoration efforts using NASA's satellites

In the past, natural tidal marshes in the south bay were segmented by levees and converted into ponds for use in salt production. In an effort to provide habitat for migratory birds and other native plants and animals, as well as to rebuild natural capital, the South Bay Salt Pond Restoration Project (SBSPRP) is focused on restoring a portion of the over 15,000 acres of wetlands in California's South San Francisco Bay. The process of restoration begins when a levee is breached; the bay water and sediment flow into the ponds and eventually restore natural tidal marshes. Since the spring of 2010 the NASA Ames Research Center (ARC) DEVELOP student internship program has collaborated with the South Bay Salt Pond Restoration Project (SBSPRP) to study the effects of these restoration efforts and to provide valuable information to assist in habitat management and ecological forecasting. All of the studies were based on remote sensing techniques—NASA's area of expertise in the field of Earth Science, and used various analytical techniques such as predictive modeling, flora and fauna classification, and spectral detection, to name a few. Each study was conducted by a team of aspiring scientists as a part of the DEVELOP program at Ames.

Tracking Restoration Progress

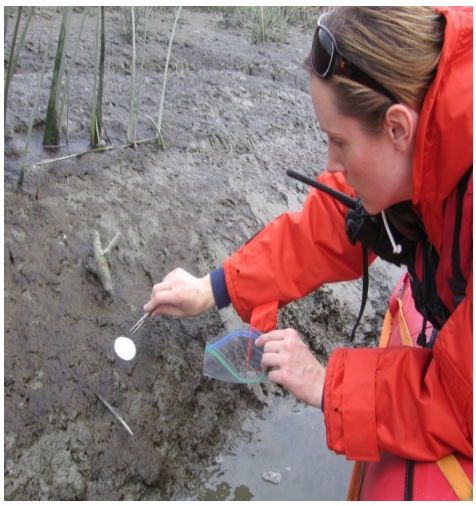
Summer 2010 students measuring 30 X 30 meter polygons to use as sites for validating satellite images.

Monitoring vegetation in the South Bay Salt Ponds with remote sensing can provide restoration managers with an indication of ecological heath and progress of development. In spring 2010, a team of DEVELOP students used NASA satellites to monitor vegetation development and to map vegetation patterns and biota changes historically, during, and after salt pond construction. The students were able to map percent vegetative cover using various vegetation indices that can be derived from satellite images. Satellites the student's used included the Moderate Resolution Imaging Spectroradiometer (MODIS) and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) onboard NASA's Terra satellite. Another study during the summer of 2010 monitored newly established marshland vegetation. This project tracked changes in vegetation distribution from 2000–2010, and mapped the spectral variation of different vegetation types. These projects found that vegetation has increased in the marshes and may provide appropriate habitat for endangered plant and animal species. These results allow the SBSPRP and partners to better understand the impacts and consequences of vegetation changes during pond restoration and indicate the success of current restoration practices.

Natural Salt Pond Responses to Change

Other projects conducted during the summer 2010 and spring 2011 terms focused on monitoring habitat stability after pond breaching or restoration. These projects included predicting sediment deposition in restored ponds in the Alviso Salt Pond Complex after a levee breach and predicting the caloric carrying capacity of mudflat habitat for migratory birds, with biofilm (an aggregate of microorganisms) as a food source. Biofilm acts as a stabilizer for mudflat sediment, and

maycontribute substantially to the food web by supporting a variety of species including mollusks, crustaceans, insects, and shorebirds. Identifying the location of biofilm and the amount present on the mudflatwill provide estimates for the amount of available food for shorebirds. This is a measure of the carrying capacity (the maximum number of a species that can survive in an environment), and will thus provide estimates of the health of the mudflat ecosystem.



Michelle Newcomer gathering biofilm samples for taxonomic classification.

After a levee is breached marshlands will rise within the salt pond which will allow plant colonization, and the establishment of a wetland ecosystem. Continued monitoring of sediment accumulation of these breached ponds will provide temporal and spatial development predictions for each phase of the restoration process. This is important in understanding how ponds behave while undergoing restoration. Once sediment has accumulated to the approximate height of sea-level, marsh vegetation can become established and thus support a variety of flora and fauna.. .

Mitigating Impacts of Restoration

Jarom Randall taking GPS points of pepperweed stands for the habitat suitability model

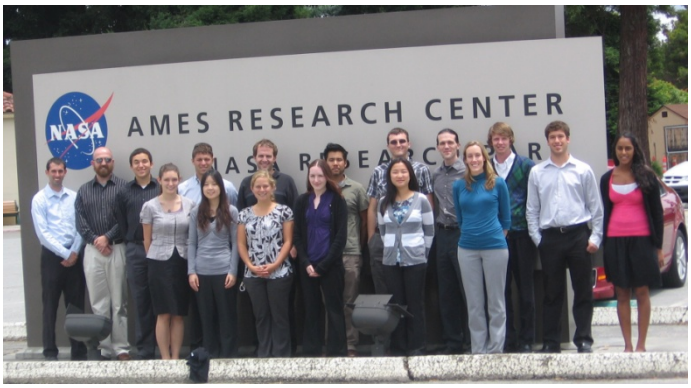
Not only is DEVELOP tracking restoration progress, but students are also assessing the consequences and providing assistance to the SBSPRP in mitigating these negative impacts. One such issue is the spread of invasive perennial pepperweed (*Lepidium latifolium*) in fragmented estuaries of the South San Francisco Bay. This plant degrades native vegetation in estuaries and adjacent habitats, thereby reducing forage and shelter for wildlife. The range of pepperweed stands within the Alviso Salt Pond Complex has expanded, as in other parts of San Francisco Bay. Mapping the current distribution of pepperweed and creating a habitat suitability model to predict spread has aided restoration managers in their efforts to monitor and aid in prevention of further spread.

Community Collaboration

These projects assist in tracking restoration progress by studying marshland vegetation behavior, pond sediment deposition, and pond habitat stability. To increase awareness and strengthen restoration efforts, these projects have all been presented in various conferences and symposiums such as The South Bay Restoration Project Symposium 2011, The American Geophysical Union Conference, The American Society for Photogrammetry and Remote Sensing, and seminars and presentations to the SBSPRP to pass on methods, data, and remote sensing techniques for restoration managers to use in the future. All data and final products are provided to the SBSPRP committee and scientists to benefit future research efforts.

About DEVELOP

The DEVELOP National Internship Program at NASA Ames Research Center (ARC) has conducted numerous applied science research projects based on community concerns and the needs of local, state, and regional agencies. For the past nine summers, selected high school, undergraduate, and graduate students have researched diverse topics such as: carbon flux, wetland restoration, air quality, storm visualizations, forest fires, groundwater management, and coastal succession. All ARC DEVELOP interns are required to conduct field work, thus allowing travel to their respective study areas in Washington, Utah, Oregon, Hawaii, Alaska, California, or Nevada. Projects are developed using data from NASA and partner satellites along with *in-situ* data and models in order to establish useful applications of NASA resources to local communities. Funding is provided by the Applied Sciences Program in the Earth Science Division in the Science Mission Directorate at NASA Headquarters. With an emphasis on "student run, student lead", the DEVELOP Program is devoted to preparing the next generation of earth science researchers.



ARC DEVELOP Interns from the summer 2011 term

To read more about ARC DEVELOP, please visit: http://develop.larc.nasa.gov/ or check us out on Facebook. To read more about the South Bay Salt Pond Restoration Project visit: http://southbayrestoration.org/

For more information on DEVELOP/ SBSPRP collaborative projects please contact the ARC DEVELOP offices at 650-604-3237.