**NCERA-101 Station Report for 2015**
**NASA Ames Research Center, Biospheric Science Branch**
**Ecosystems Science & Technology Lab**
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**Facilities and Equipment**:
*Aquatic Plant Facilities* - New controlled environment facilities have been installed at NASA Ames Research Center to enable ecophysiology study of aquatic plants, especially invasive aquatic plants, as affected by climate change and drought conditions. This represents an expansion of facilities already operational to study terrestrial invasive plants.

*Remote Sensing of Aquatic Plants* – Remote sensing of aquatic vegetation is performed in controlled environments (environmental manipulation), using airborne sensor system (validation in field setting with on-water truth), and utilizing satellite collections (transfer to operational resource management agencies).

Top Photo: Water Hyacinth (*Eichhornia crassipes*) an invasive floating aquatic plant growing in controlled environments.
Bottom Photo: Coontail (*Ceratophyllum demersum*), a native submerged aquatic plant often exhibiting invasive growth, in controlled environment culture.

**Unique Plant Responses**:
Controlled environment studies are designed to **provide unique spectral reflectance signatures** to support remote sensing of specific aquatic plants or to **provide ecosystem simulation models with missing growth parameters for specific plants in response to altered environments**. Remote sensing signature definition is focused on Water Hyacinth (floating) and *Egeria densa* (submerged). Plant response to altered water quality, light environment, agricultural runoff, non-target pesticide effects, and temperature resulting from climate change and drought conditions are being studied.

**Accomplishment Summaries**:

*New Project Initiated* – California Delta Areawide Project for Integrated Resource Management. The California Sacramento-San Joaquin River Delta is the hub for California's water supply and critical to ecosystem heath in the Delta/SF Bay complex. Delta water supplies millions of people and businesses with drinking and agricultural irrigation water within the San Francisco Bay and Delta regions and water is distributed to southern California to support agricultural production and large urban communities. Decades of competing demands for Delta resources, climate change and drought conditions resulted in diminished overall health of the Delta. Aquatic weeds are currently detrimental economically, environmentally, and sociologically in the Delta. They negatively impact the redistribution of water and disrupt the ecology of the Bay Delta food web. In response to these challenges NASA and the United States Department Of Agriculture (USDA) Agricultural Research Service have partnered along with State of California and local Delta governments to help in restoration and long-term sustainability of the Delta in a collaboration that supports science-based, adaptive-management strategies. The overall mission is to improve reliability of water supply and restore a healthy Delta ecosystem while enhancing agriculture and recreation.

*Floating Aquatic Plants* – Spectral signatures for Water Hyacinth were developed, validated on water, and the Water Hyacinth Mapping Product developed for operational testing. Mapping Product utilizes satellite collections and provides routine map of hyacinth location, coverage, density, and biomass for large or small areas. **Operational Water Hyacinth Mapping Product has been transferred to California Department of Boating and Waterways for operational testing.**

Example of Hyacinth Mapper Product showing hyacinth distribution part of the California Delta. Dark blue pixels represent greater than 50% coverage.

*Submerged Aquatic Plants* – Making remote sensing measurements for submerged aquatic plants have serious obstacles; both in lack of biological signal definition and radiation dynamics. A team of remote sensing instrumentation experts have joined with the ecophysiology group to define and understand the source of error. Controlled environment and airborne hyperspectral sensor studies are providing significant progress.

*Ecosystem Modeling* – The Soil Water Assessment Tool (SWAT) simulation modeling tool has been modified to include mixed agriculture, urban, and aquatic systems in the California Delta (San Francisco Bay / Sacramento and San Joaquin River System). The Delta-SWAT Tool provides model simulations of ecosystem response to altered environmental regimes and resource management practices in the area. Component models parameterizing aquatic plant response to altered environments and management practices are being defined and updated using controlled environment study results.

*Controlled Aquatic Environment Chambers* – Controlled environment facilities for study of aquatic plants (native and invasive species) have been established over the past year and are in use to fill gaps in ecosystem model parameter inputs. Response to water quality (pesticides and nutrients), light (increasing water clarity), and temperature are current focus.

**Impact Statements**:

• Effective water management in the California Sacramento-San Joaquin River Delta is essential to maintaining California agriculture and communities statewide. Drought and climate change have affected ecosystem health, water quality and ability to reliably deliver water. Invasive aquatic weed expansion affects ecosystem health, commerce and water supply. NASA is using Controlled Environment Facilities to study the effect of altered environmental conditions on growth and distribution of aquatic plants and works with USDA and State Agencies to implement science-based management strategies to mitigate weed effects on ecosystems and water distribution.

• NASA Ames Research center has delivered a Water Hyacinth Mapping Tool to the California Department of Boating and Waterways for operational use in planning and implementing management program for aquatic weeds.