

Title: Co-Optimization of Duckweed Biomass, Nutritional Quality, & Input-Use Efficiency

ASGSR 2019 Abstract: Space Lab and the University of Colorado at Boulder (CU) are investigating duckweed plants (family *Lemnaceae*) as a possible crop for crew diets. This research investigates environmental modification of duckweed plants *to increase nutrient content while maintaining high volumetric yield and CO₂ sequestration during a space mission*. The research goal is to environmentally (rather than genetically) modify duckweed plants for superior yield, nutritional density, and energy-use efficiency (biomass/antioxidants produced per energy input), at spacecraft-relevant CO₂ levels (up to 1%). A proposed innovative pulsed lighting technique avoids the *yield/micronutrient trade-off* with a previously validated combination of a moderate, growth-rate-saturating continuous PFD interspersed with short higher-light exposures. This technique stimulates micronutrient accumulation, including the eye protector zeaxanthin, while avoiding growth inhibition. This research will also investigate the effects of spectral density (or quality) on energy-use efficiency (biomass and zeaxanthin/antioxidant content per power consumed). In the first year of the project, we will demonstrate the accumulation of protein, antioxidant vitamins, and other essential micronutrients in *Lemna gibba* and *Wofflia microscopica* under high light and ambient CO₂. We also will quantify growth-saturating continuous light intensities at space relevant CO₂ levels (up to 1%). This presentation will highlight the research results obtained to date and summarize the pulsed lighting experiments under elevated CO₂ that are planned for Year 2 of the project. This research is supported by TRISH through NASA grant NNX16AO69A.

Christine is co-founder, co-owner, and Vice President of Space Lab Technologies, LLC and this research project's Co-Investigator. Her multi-disciplinary education spans systems engineering, bioastronautics, and life sciences, providing her with a unique combination of skills for space crop production technology development. She is currently a PhD student at the University of Colorado Boulder, studying the optimization of environmental conditions for duckweed yield and nutritional quality in space applications. Before coming to the University of Colorado, she was a Systems Engineer and Mission Manager for the NASA Sounding Rocket Operations Contract (NSROC). She co-founded Space Lab Technologies, LLC in 2016, with the mission of advancing technology for human exploration of deep space. At Space Lab, her responsibilities include project management, business development, systems engineering, integration and testing support, data analysis, technical writing, and research for all projects. She was also Principal Investigator for Space Lab's *μG-LilyPond*[™] project, a floating plant cultivation system for microgravity, under NASA STTR Phase II contract.