Optimizing Selection Pressures and Pest Management to Maximize Algal Biomass Yield [OSPREY] *submitted by the New Mexico Consortium*

Principal Investigators
Dr. Alina Corcoran (Research Scientist, New Mexico Consortium)
Dr. Shawn Starkenburg (Scientist 4, Los Alamos National Laboratory)

Major Participants
Industrial Partners: Qualitas Health, Cyanotech Corporation, Phase Genomics
Academic Partners: Colorado State University, New Mexico State University, University of California San Diego

Project Description
This project responds to a critical industry need to improve annualized productivity, stability, and quality of algal production strains for biofuels and bioproducts. We aim to generate process innovations rooted in outdoor cultivation for strain selection, maintenance, cultivation, improvement, and pest management that will result in a 50% improvement in harvest yield and robustness and 20% improvement in conversion yield. Our project's components, (1) Balancing Indoor and Outdoor Selection Pressures, (2) Optimization of Pest Management, and (3) Improvement of Field Strain Performance and Composition, are built on a single foundation: the year-round cultivation of an algal biofuel strain in outdoor systems at Qualitas Health (Imperial, TX), Cyanotech Corporation (Kona, HI), and the California Center for Algae Biotechnology (San Diego, CA) for three years. At the start of the project, we will use a field-adapted strain collected to seed ponds at the other field sites. The unique environmental selection pressures of each outdoor system will allow us to naturally develop robust cultivars with different environmental tolerances. We will also establish the field-adapted strain in each of three laboratories under three different maintenance regimes. Throughout the project, we will track trait evolution and drift across the field and lab sites. Quantification of the magnitude and time scales of trait shifts in the laboratory and field will allow us to develop data-driven recommendations for processes such as scaling and seeding. To better manage pests, we will utilize metagenomic tools to understand the underlying causes of periods of low productivity in the field and identify putative pests/pathogens. We will also develop and test custom near-real time field-deployable tracking tools. As pest management tools come online, they will be validated and deployed at the Qualitas and Cyanotech sites. Finally, we will use non-GM approaches to improve the baseline field-adapted strain, focusing on productivity, resilience and composition. We will test new and improved strains as well as process innovations (e.g., changes to laboratory strain maintenance or seeding) at the outdoor testbed at New Mexico State University. Finally, we will assess improvements through sustainability modeling based on open raceway pond growth architectures. The work will leverage existing models and incorporate multiple production pathways, including fuel and co-product production. Our approach is unique because it relies on natural, outdoor selection pressures to drive fitness in strains that have already been identified as standards in the industry. Moreover, the work has broad relevance to algal biofuel and bioproduct industries as the proposed pipelines can be applied to a variety of systems regardless of strain, location, or product.