

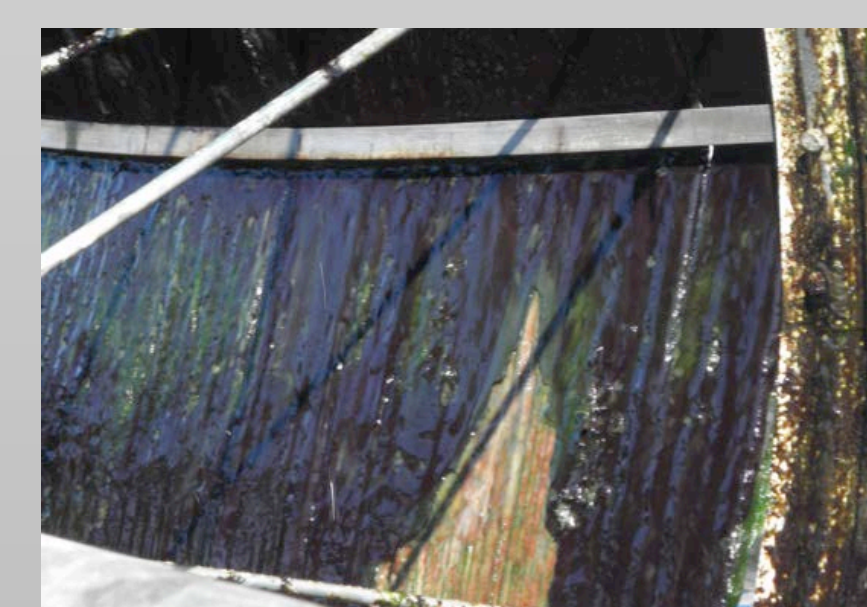
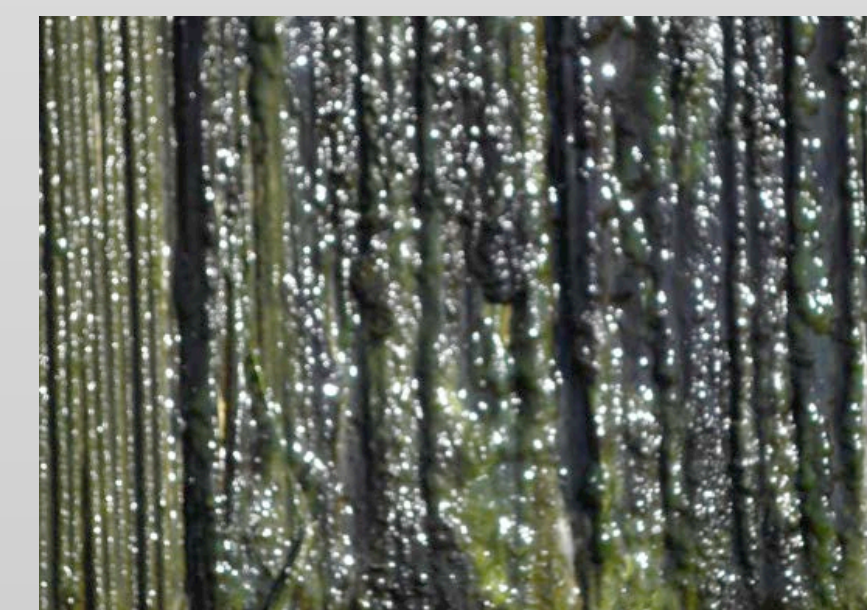
Phycocyanin from Cyanobacterial Biofilms Grown in Municipal and Produced Wastewaters

Abstract

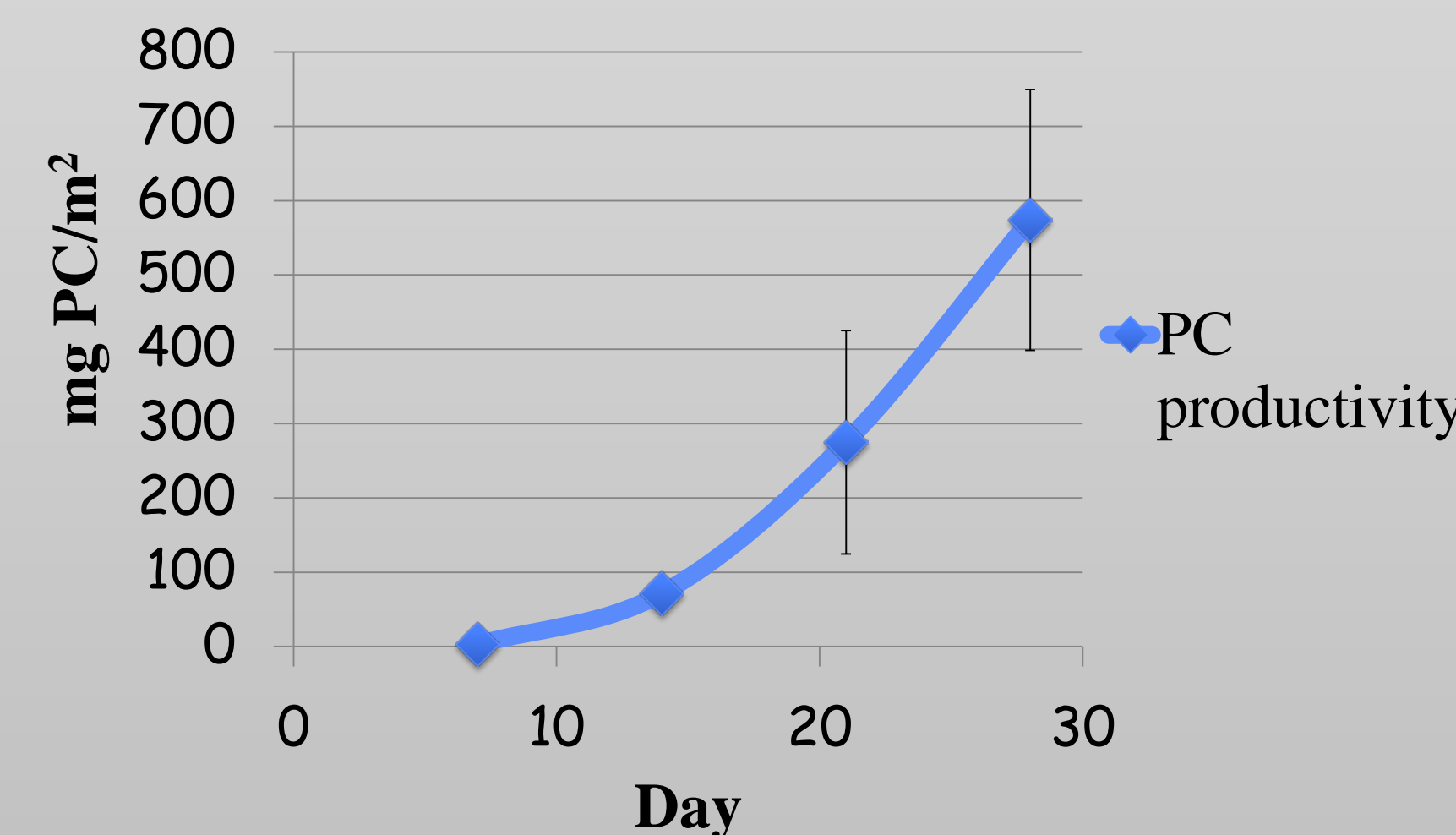
Phycocyanin is a high-value pigment that may be used for a variety of applications. Potential uses include immunoassay markers, dyes, and as feedstock for pharmaceutical and nutraceutical preparations such as mesobiliverdin-IX α , a cytoprotective anti-inflammatory agent that is a close homolog in structure to biliverdin-IX α . The main objective of this research was to produce phycocyanin using cyanobacterial biofilms cultured on oilfield wastewater (produced water) to bioremediate the wastewater and decrease disposal costs while producing the high-value pigment. Cyanobacterial biofilms were cultured utilizing Rotating Algal Biofilm Reactors (RABRs) in full strength produced water and harvestable biomass and extracted phycocyanin yields were determined. RABRs operating in Produced Water Medium yielded 434.8mg phycocyanin/m² substrate surface area with a crude extract purity of 0.324. Average reduction rates of Total Nitrogen and Total Phosphorous were 18.1mg N/1-day and 7.4mg PO₄⁻³/1-day respectively. A secondary objective was to quantify phycocyanin yields from mixed culture biofilms grown on pilot-scale RABRs in municipal wastewater. A Pilot-Scale RABR operating with a 12hr retention time at a municipal wastewater treatment facility yielded 574.1mg phycocyanin/m² substrate surface area. It is concluded that cyanobacterial biofilms grown in these municipal and produced wastewaters are a viable source of phycocyanin.

Municipal Wastewater

Pilot-Scale RABRs at the Logan Lagoons wastewater treatment facility show spatially differential growth with respect to phototrophic organisms



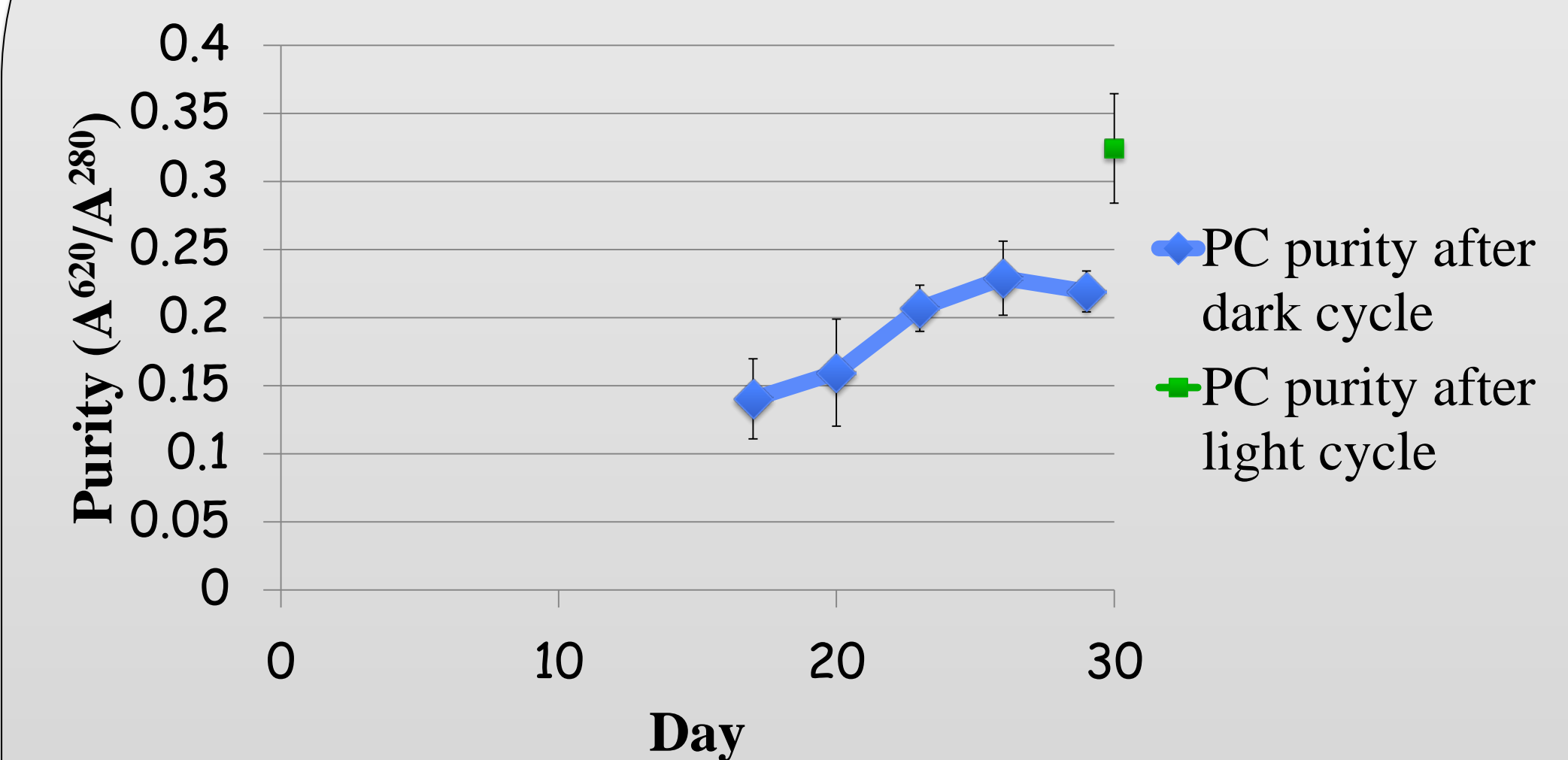
Phycocyanin (PC) Productivity from Municipal Wastewater



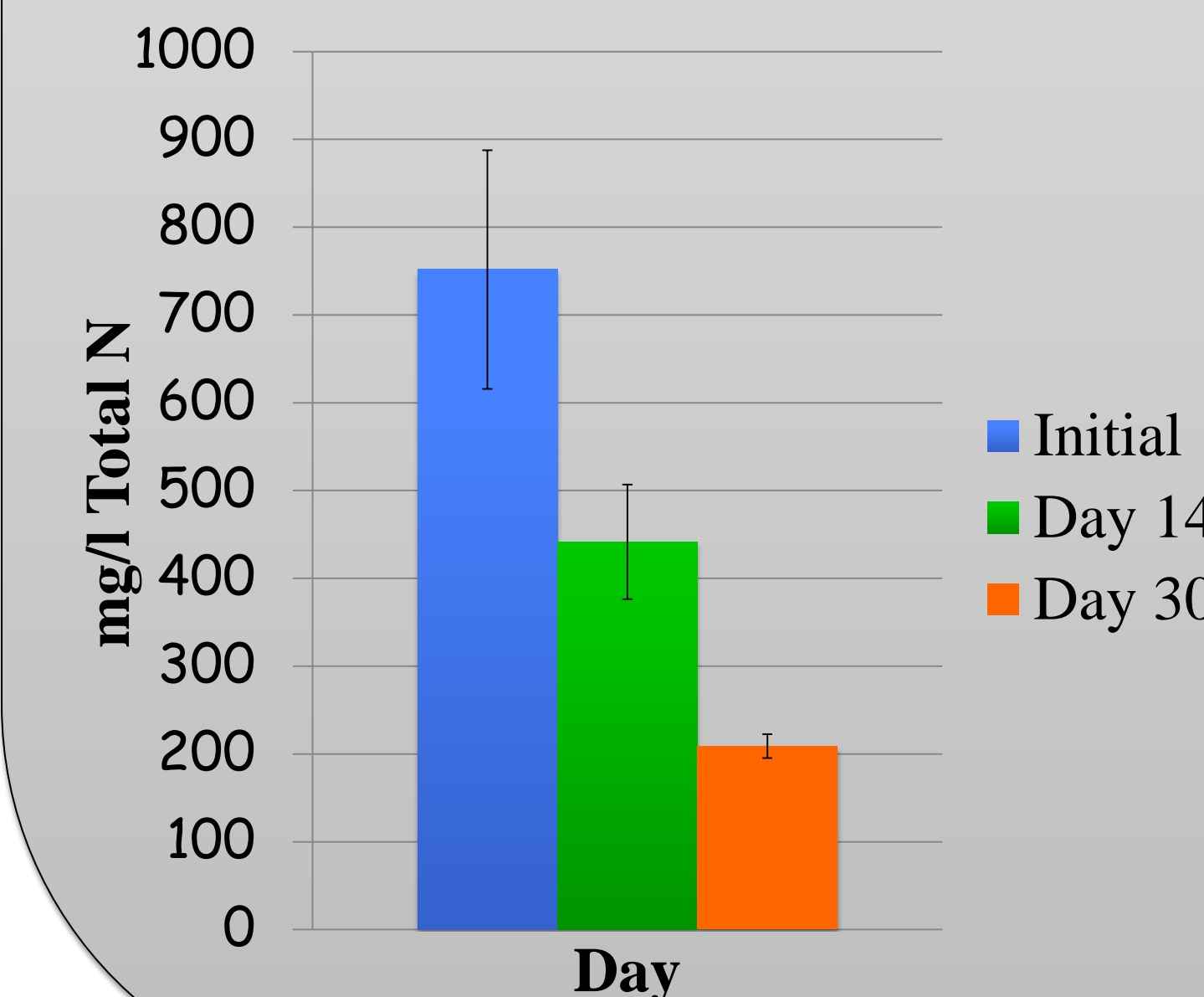
*Acknowledgment: Terrence Smith, for biomass growth data and samples

Produced Water Cont.

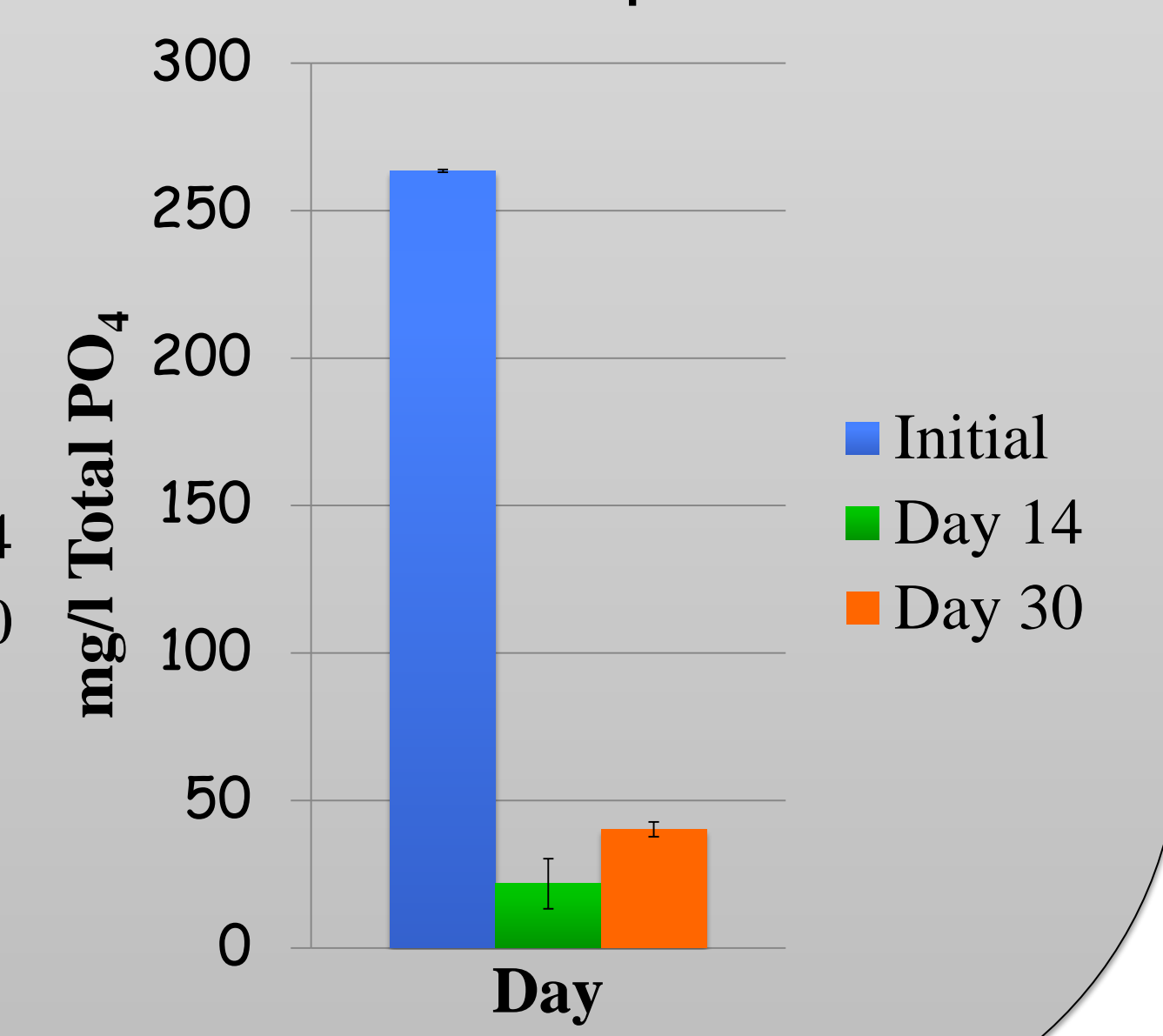
Phycocyanin (PC) Purity



Total N Removal



Total PO₄ Removal



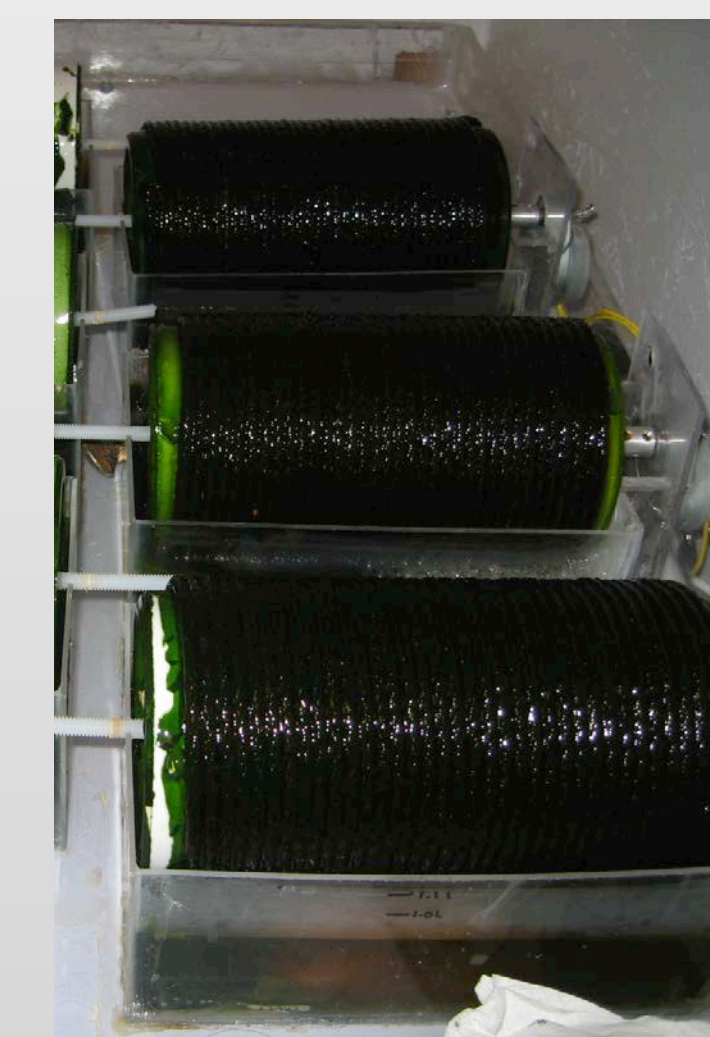
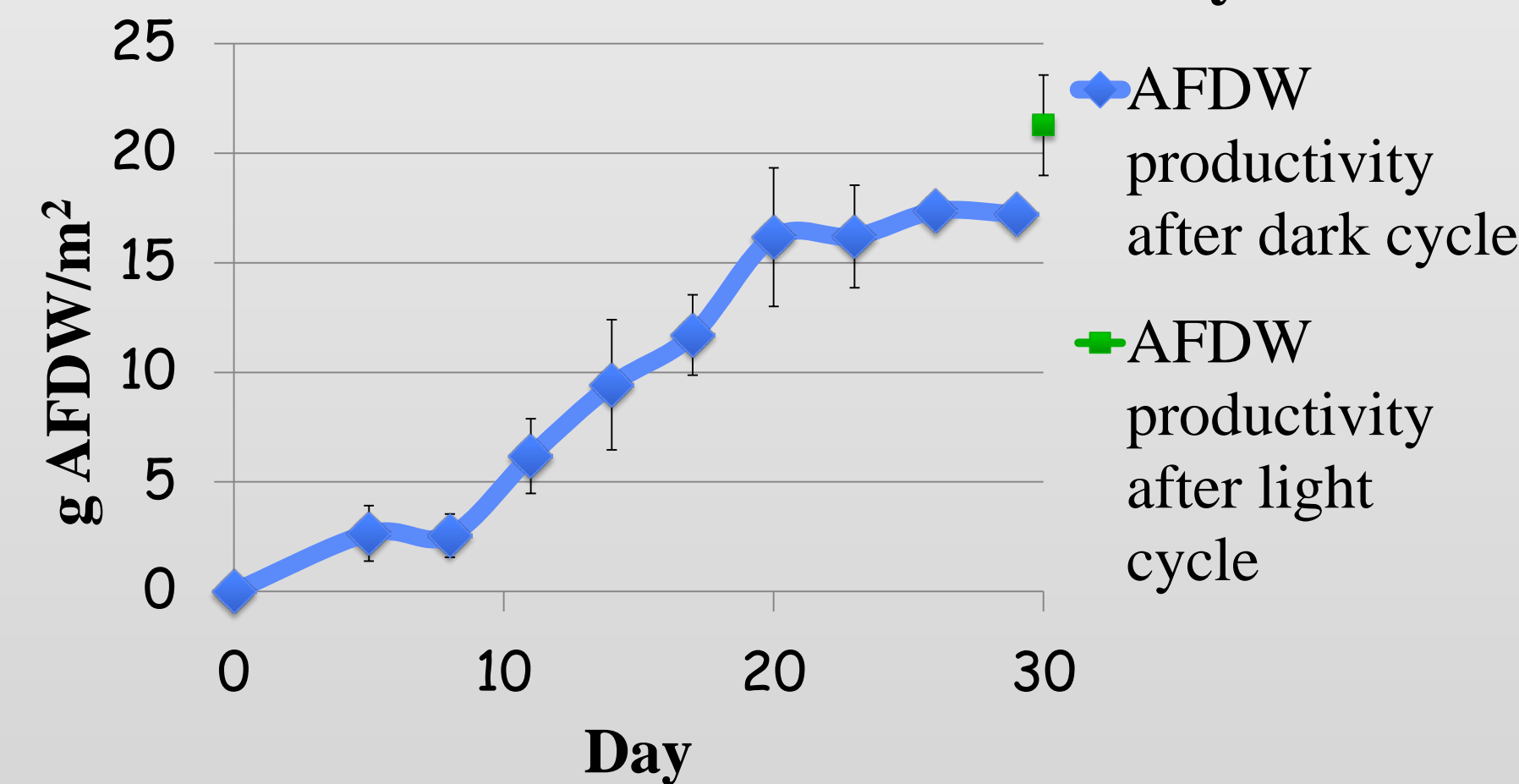
Background



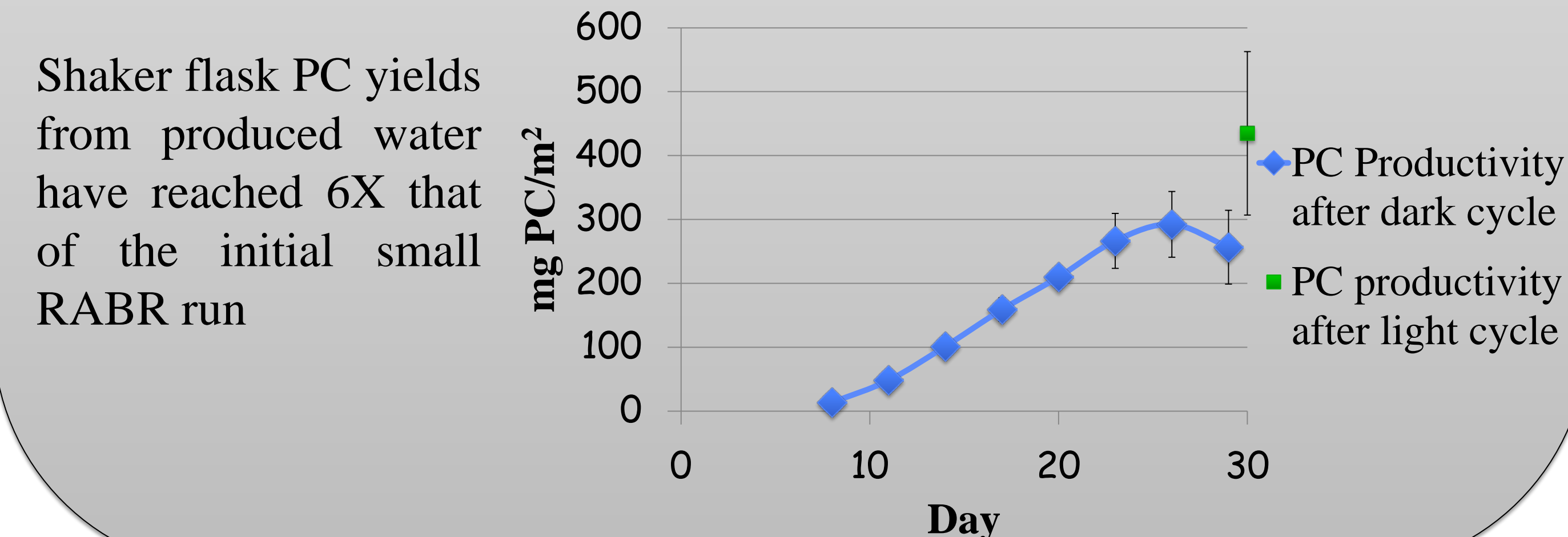
- Produced water is the saline wastewater that is generated during the hydrocarbon drilling and extraction process
- Produced water is the largest single waste stream generated by the oil and gas industries
- Produced water generation is increasing due to aging wells and new natural gas recovery practices
- Phycocyanin is a high value pigment found in most cyanobacteria
- Phycocyanin is popularly used as a laboratory fluorescent label and may also be used as feedstock for the production of mesobiliverdin-IX α
- Mesobiliverdin-IX α has recently been shown to greatly increase pancreatic islet cell viability during transplant surgeries designed to cure type 1 diabetes

Produced Water

AFDW Biomass Productivity



Phycocyanin (PC) Productivity from Produced Water



Shaker flask PC yields from produced water have reached 6X that of the initial small RABR run

Conclusions(•) and Future Work(-)

- Production of phycocyanin from cyanobacterial biofilms grown on produced water and municipal wastewater is possible and can easily fit into many existing algae processing procedures
- Improvements in purity can be made by washing biomass flocs prior to processing
- Cyanobacterial biofilms significantly remove Total Nitrogen and Total Phosphate from produced water
- Continue small RABR studies to test the effect of light shading on pigment production
- Explore new cyanobacterial strains that tolerate produced water and generate high value pigments
- Examine micronutrient (metals) removal by biofilm growth

