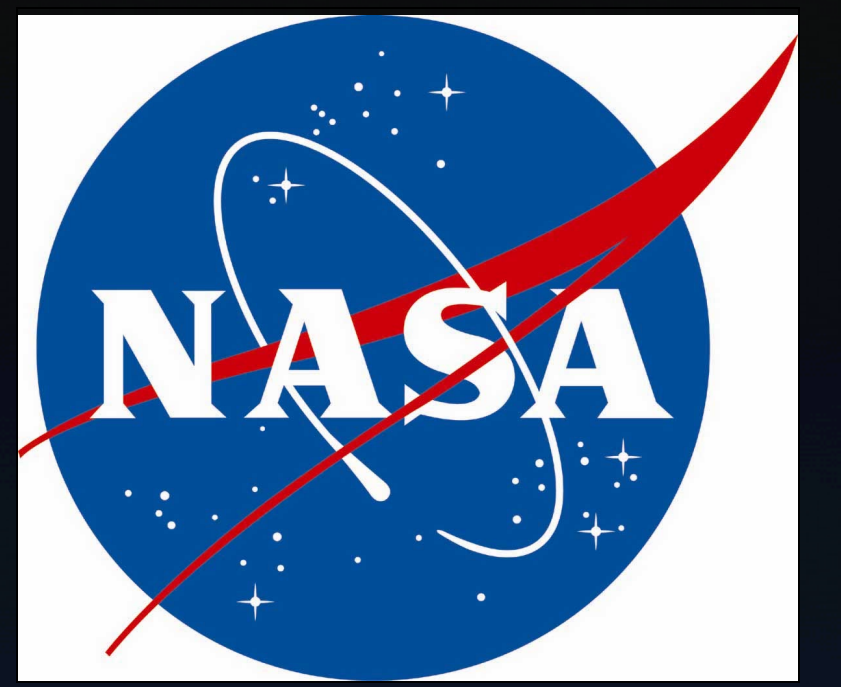


# Simplified Microbial Mats: Unraveling a Complex Community One Alga at a Time



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## BACKGROUND

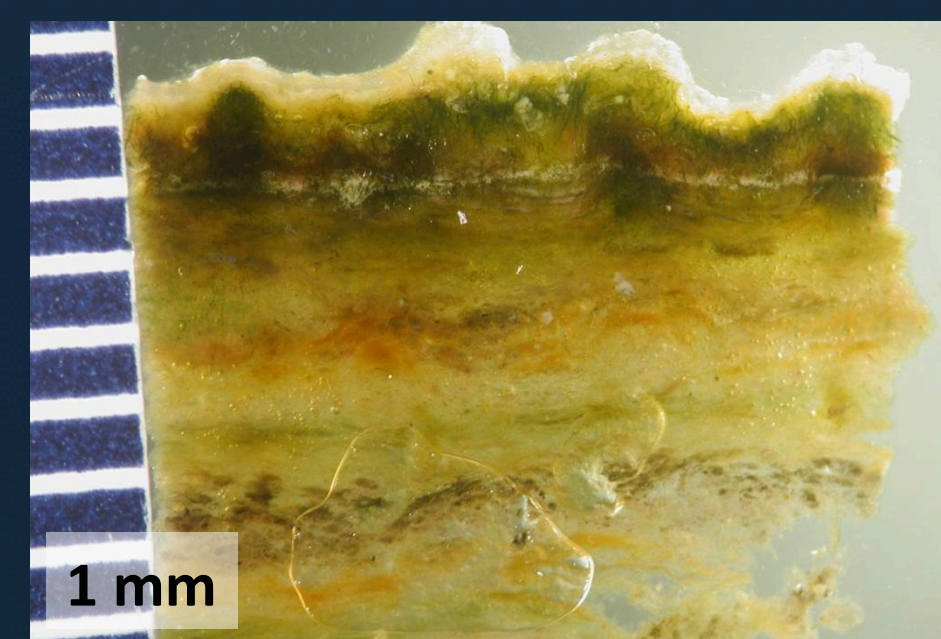
- Microbial mats are the oldest known ecosystems with a 3.4 billion-year fossil record.
- These photosynthetic mats are responsible for our oxygen-rich atmosphere.
- They are rich in diversity on a physiologic and phylogenetic level, ranking amongst the most complex systems on earth.
- They can be found in lakes, streams, soil, rain gutters and in extreme environments (i.e. hot, cold, dry, salty).
- Understanding their structure and function will help us better understand the biological evolution of life on early earth.
- Microalgae growing on flat artificial substrates may be useful for NASA bioregenerative life support and In Situ Resource Utilization (ISRU) applications.



## OBJECTIVE

In this investigation, we aim to:

- Develop an effective method to study microbial mat organisms in relatively uncomplicated ecosystems that mimic the way they grow in nature.

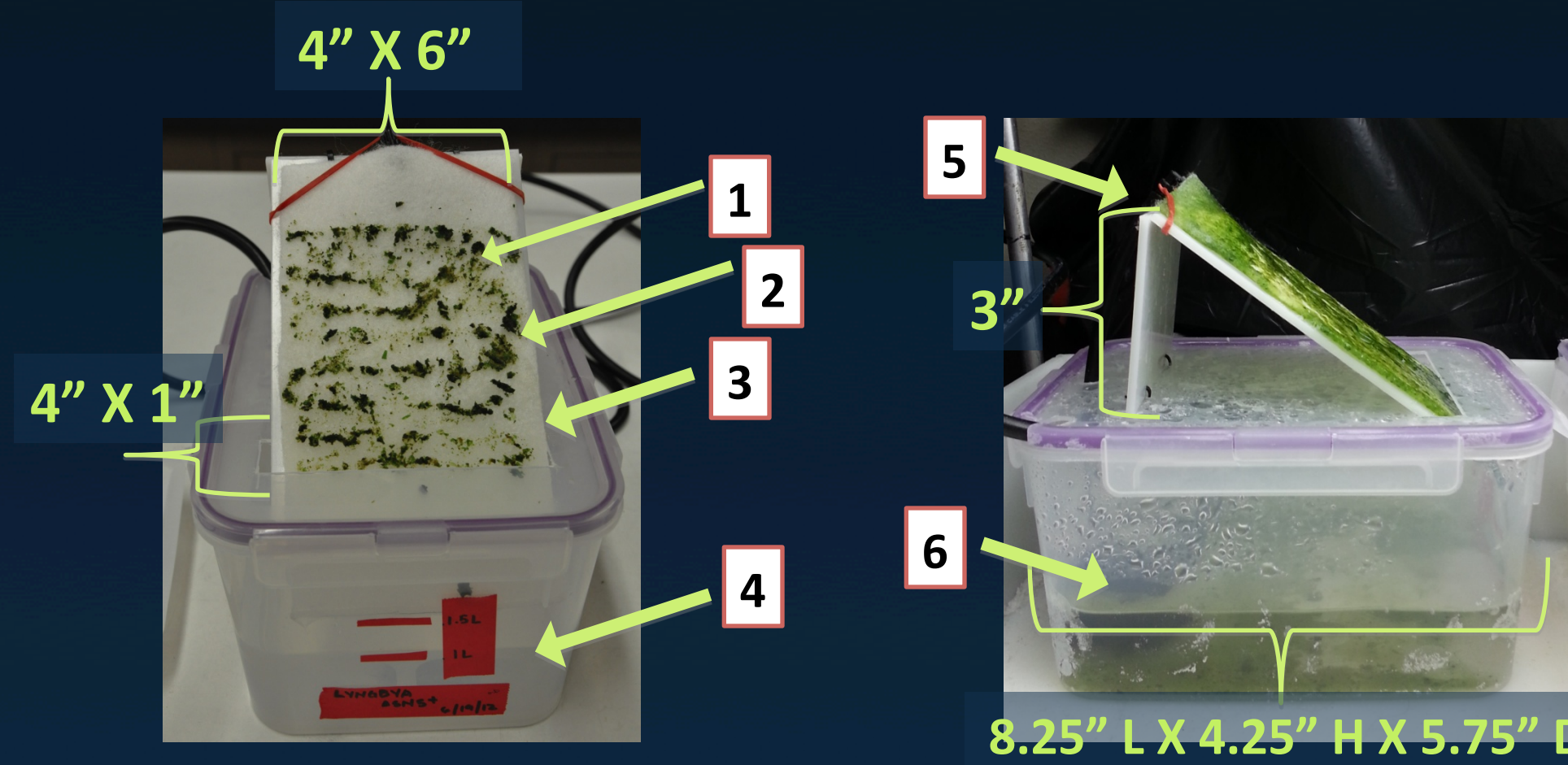


- By growing "simplified microbial mats" on polypropylene cloth, we are able to observe the range of biogeochemical processes of a single species in a biogeochemical setting that approximates in situ conditions.

## METHODS OF ANALYSIS

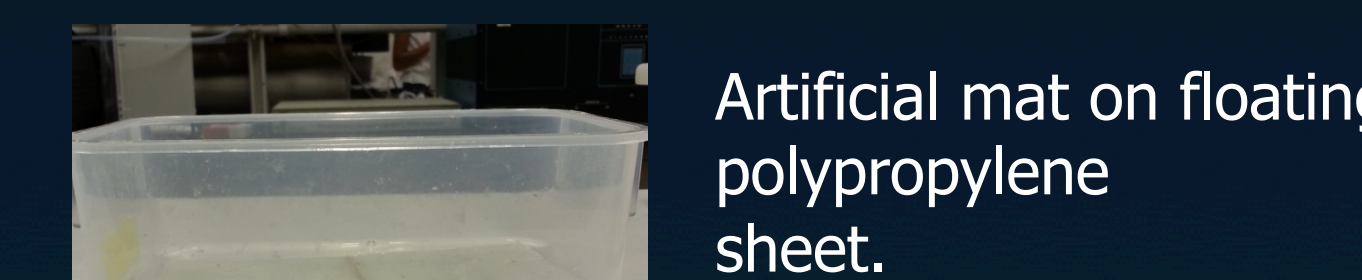
- Ion Chromatograph - to measure nutrient (nitrate and phosphate) concentrations in the media.
- Gas chromatograph - to measure hydrogen production in light and dark treatments.
- Pulse amplitude modulation (PAM) fluorometer - to record photosynthetic efficiency of each sample.
- Microscopic photographs - to observe exactly how these organisms were using the polypropylene cloth as a substrate.
- Digital SLR camera - to document overall growth.

## SETUP: TRICKLING FILTER BIOREACTOR

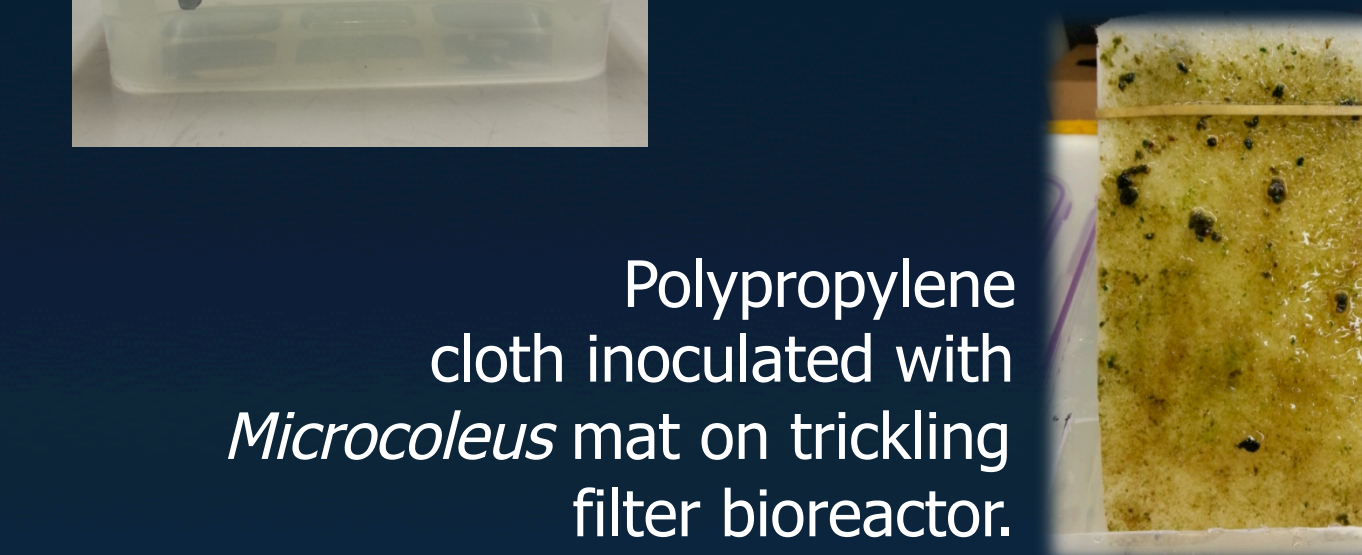


1. Inoculated with cultures of: *Lyngbya*, *Microcoleus*, or *ESFC-1* (*Elkhorn Slough Filamentous Cyanobacteria*)
2. Polypropylene Cloth
3. Polypropylene Sheet supporting mat (3mm thick)
4. ASN5+ media
5. Tubing with L-connector
6. Pump

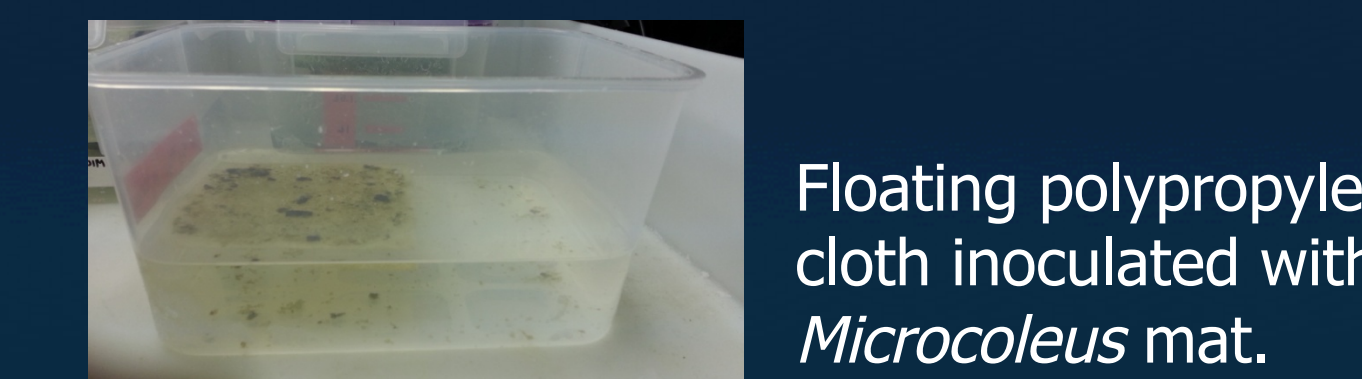
## ADDITIONAL SETUPS (FOR FUTURE ANALYSES)



Artificial mat on floating polypropylene sheet.



Polypropylene cloth inoculated with *Microcoleus* mat on trickling filter bioreactor.



Floating polypropylene cloth inoculated with *Microcoleus* mat.

## OBSERVATIONS

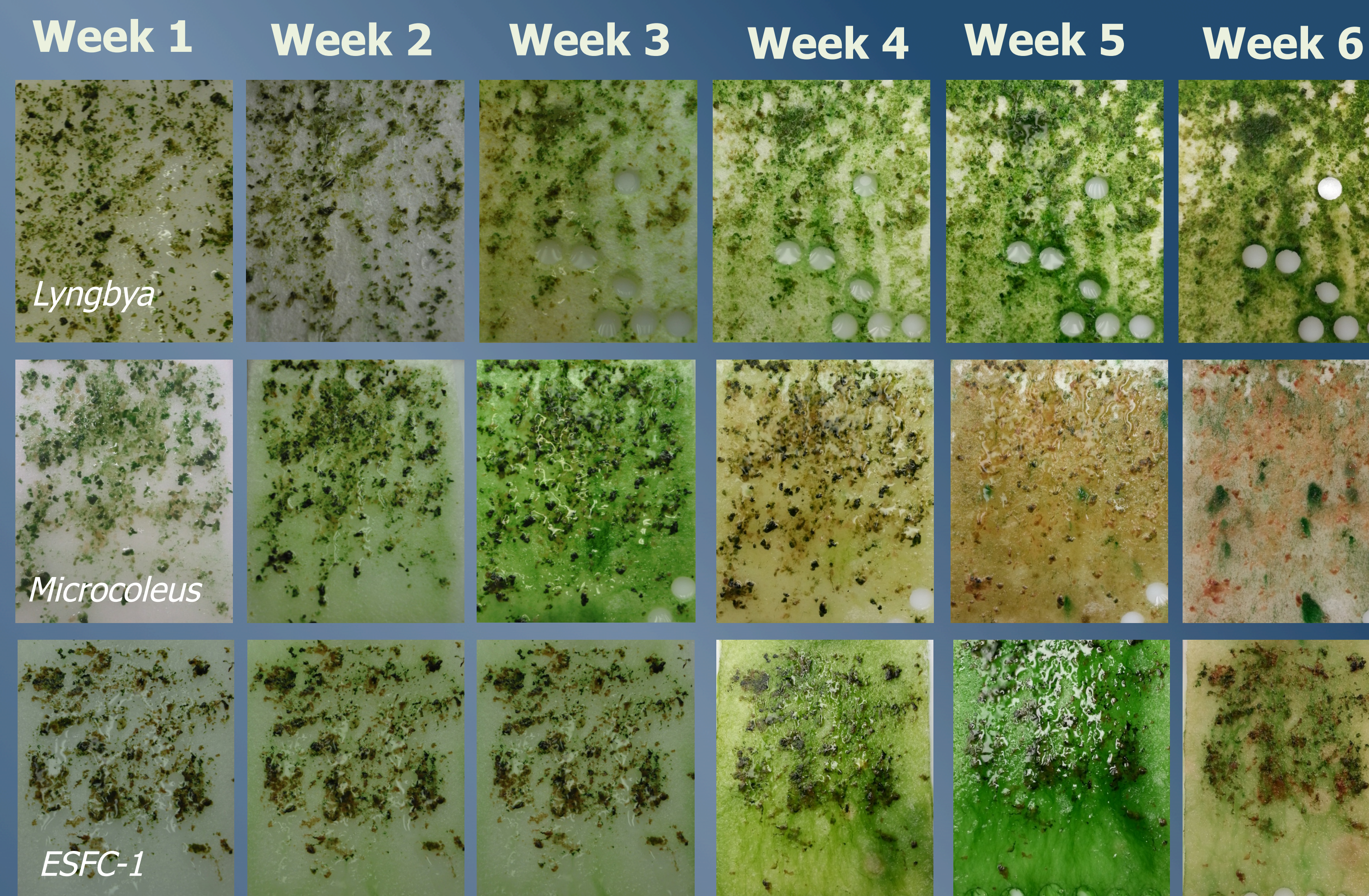


Figure 1. Growth of "simplified microbial mats" over 6 weeks.

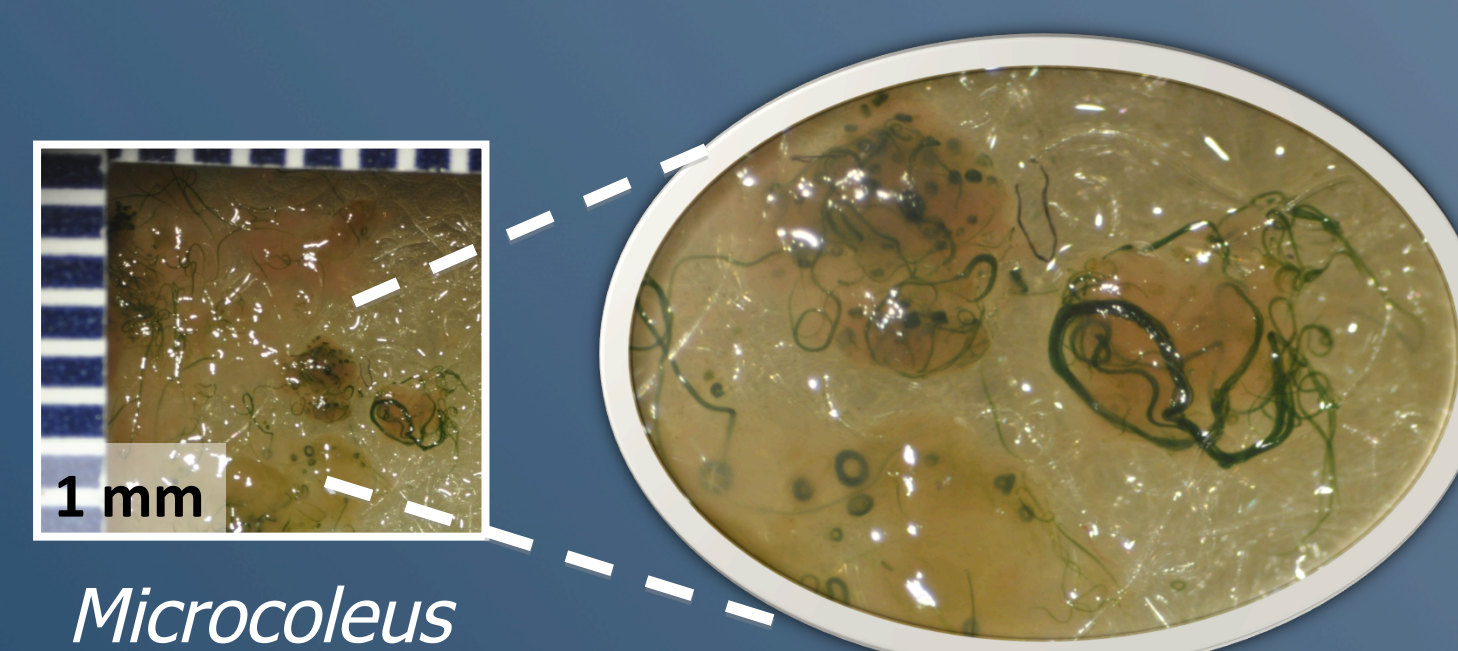
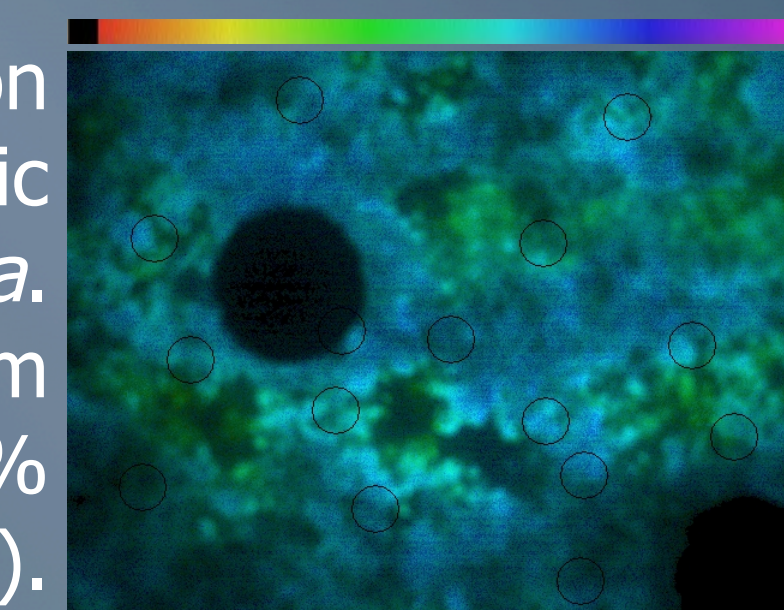


Figure 2. Microscopy Image

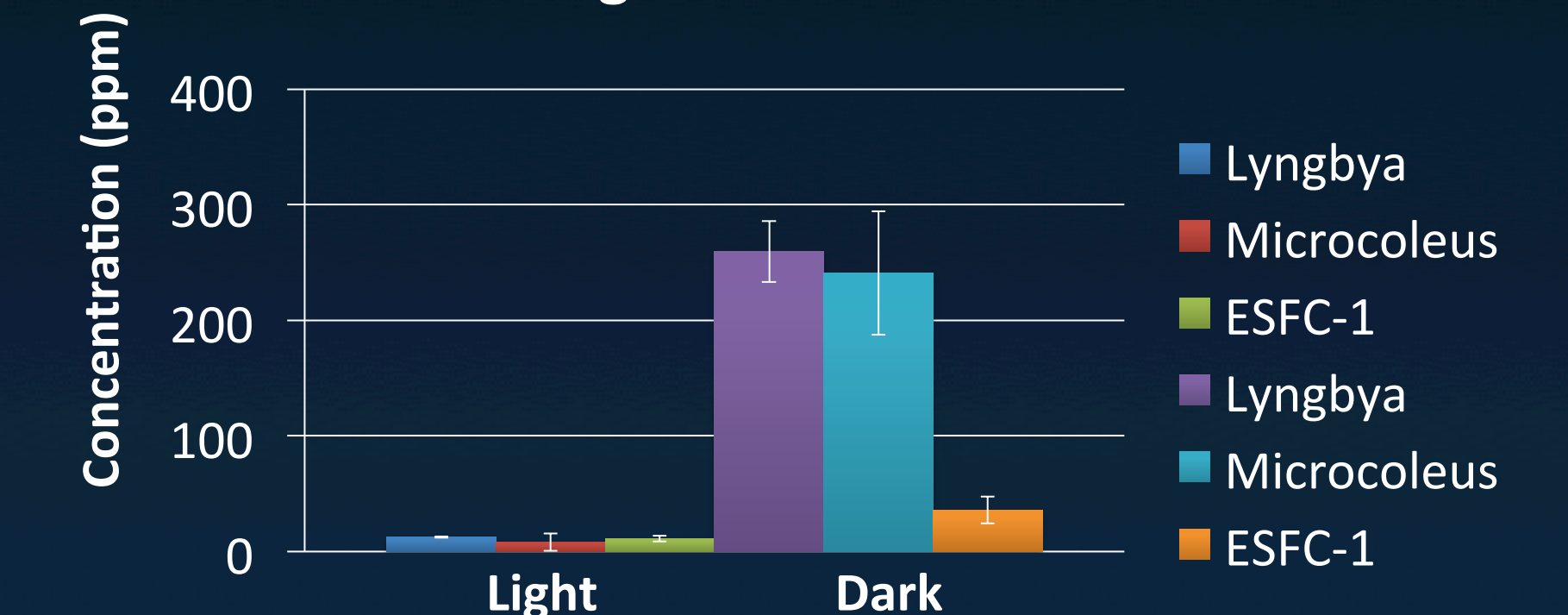
## Figure 3. P.A.M. Fluorometer Image

Spatial distribution of photosynthetic yield on *Lyngbya*. Spectral scale from 0% (black) to 100% efficiency (purple).

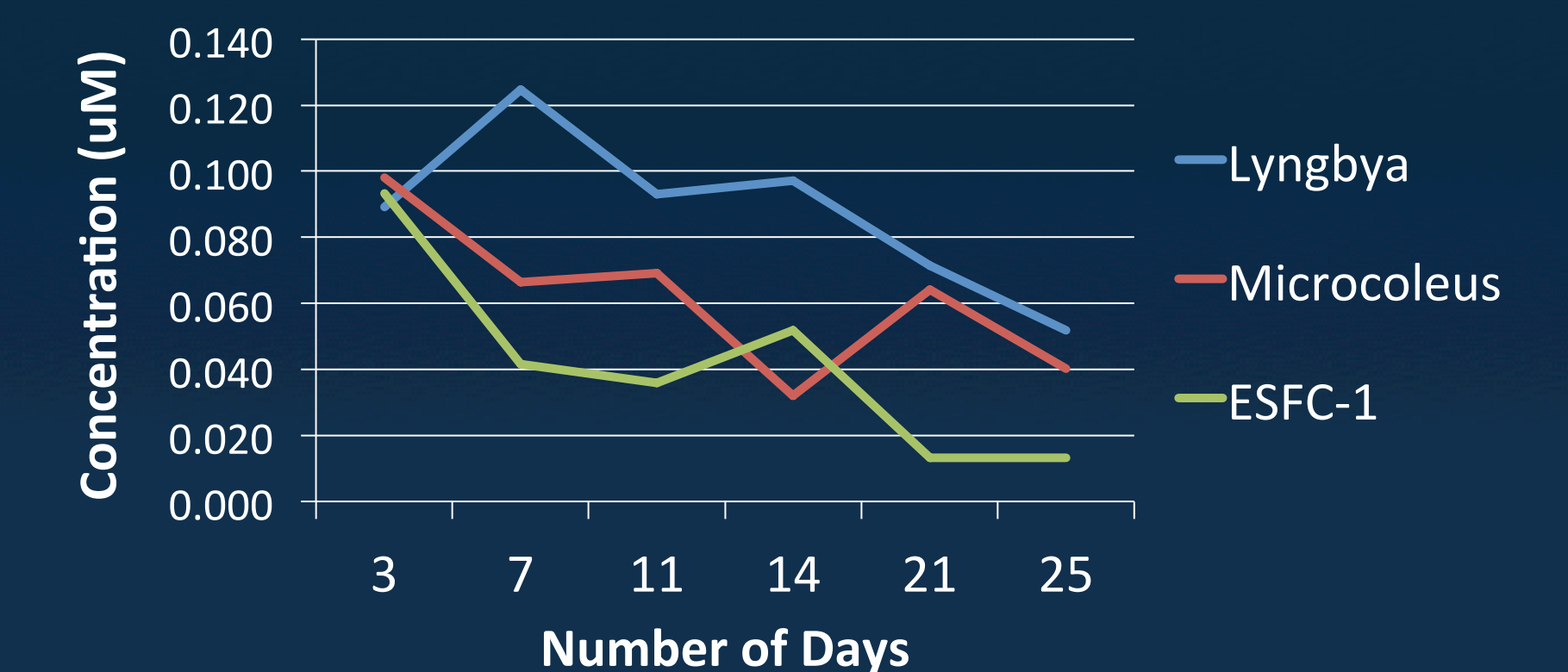


## ANALYSES

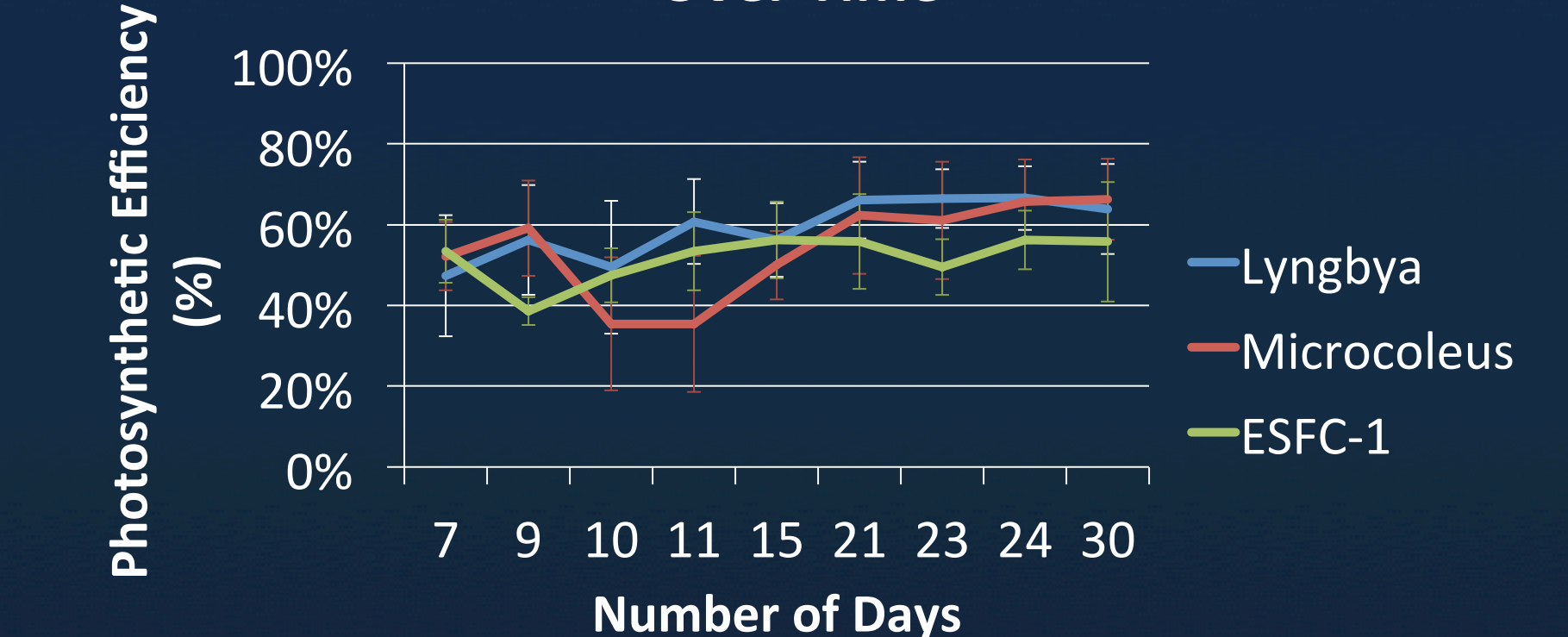
Graph 1. H<sub>2</sub> Concentrations of "Simplified Mats" in Light and Dark Treatments



Graph 2. NO<sub>3</sub> Concentration Over Time



Graph 3. Photosynthetic Efficiency Over Time



## SUMMARY

These "simplified mats" are exhibiting similar behavior as seen in its natural environment. The *Lyngbya* and *Microcoleus* mats produced higher levels of H<sub>2</sub> in the dark versus the light treatments (graph 1), with the exception of the *ESFC-1* for reasons not yet known. In addition, photosynthetic efficiency increased over time (graph 3), while nitrate levels decreased (graph 2).

This study will be setting the foundation of future investigations of microbial mat communities.