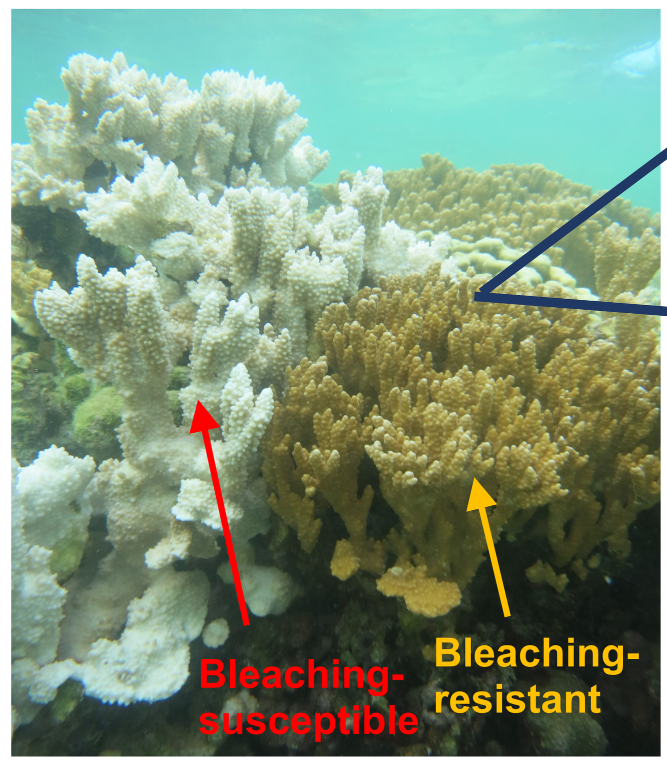
Katelyn Jones
Junior in the College
Major: Biology
Lab: Dr. Katie Barott
Twitter: @KatieDoesBio

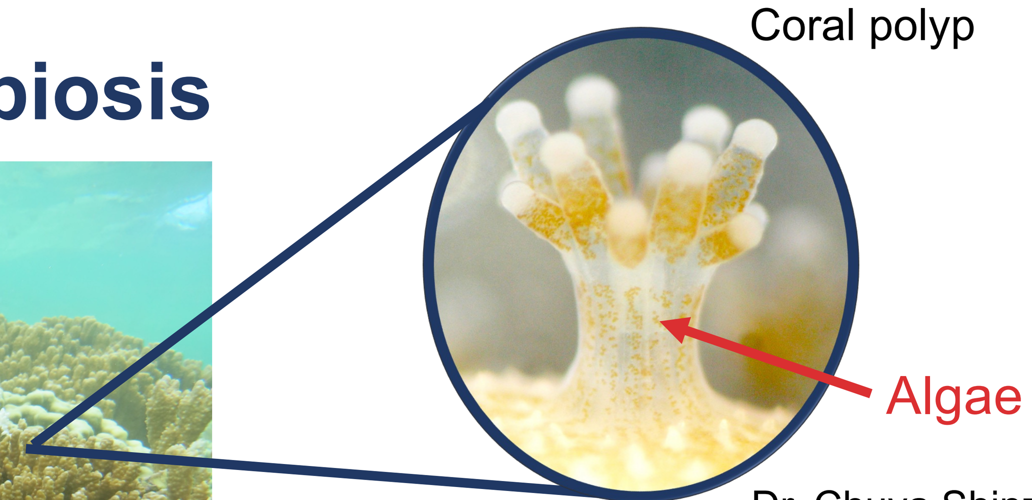
Penn CURF — Center for Undergraduate Research & Fellowships

Heat stress drives pHi acidification in aiptasia, the model system for coral.

Corals + Symbiosis



Dr. Katie Barott, 2017



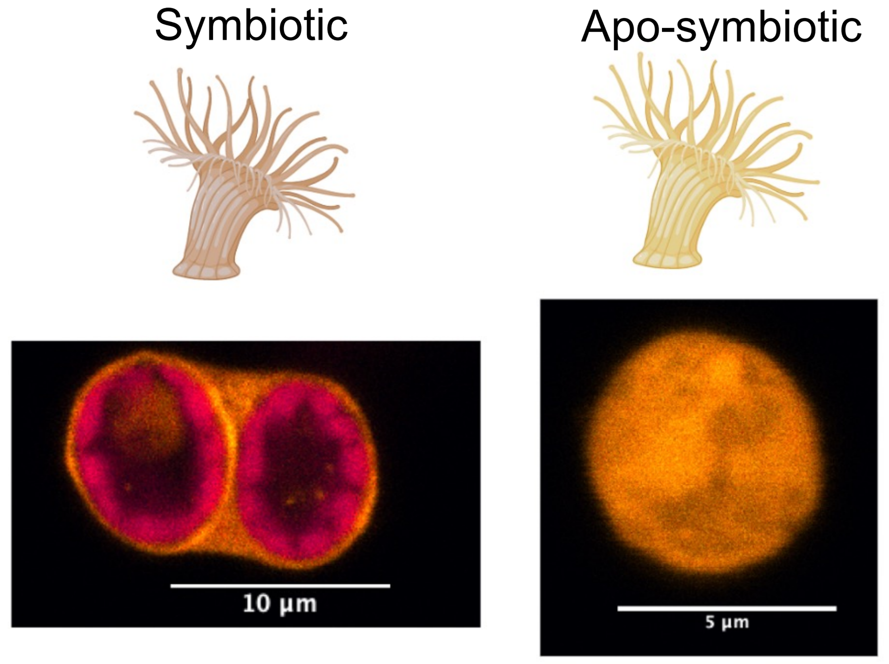
Dr. Chuya Shinzato via OIST

- Corals are animals
- Coral colonies are covered with individual polyps (right)
- Corals have a symbiosis with algae that provide sugar from photosynthesis

However:

Climate change ⊣ Symbiosis → Bleaching (algae are expelled) → Starvation and/or death

Model System

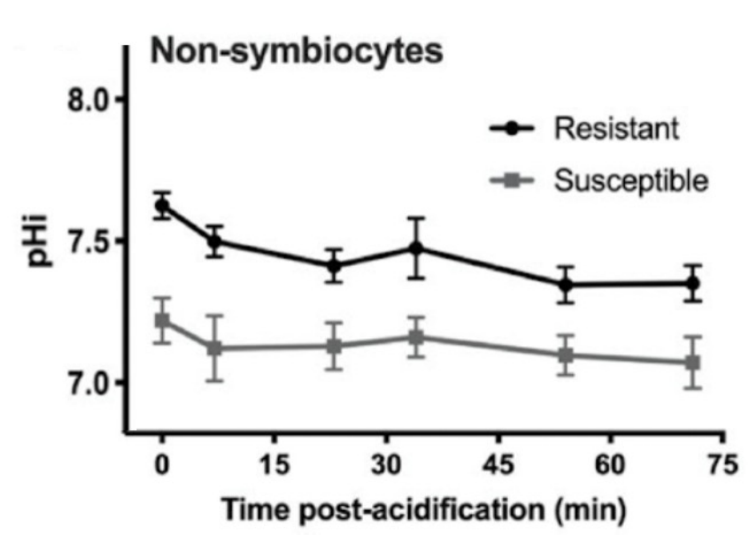


- The sea anemone *Exaiptasia diaphana* (aiptasia) is a model system for symbiosis in corals
- Apo-symbiotic anemones (without symbionts) can thrive without risk to their health

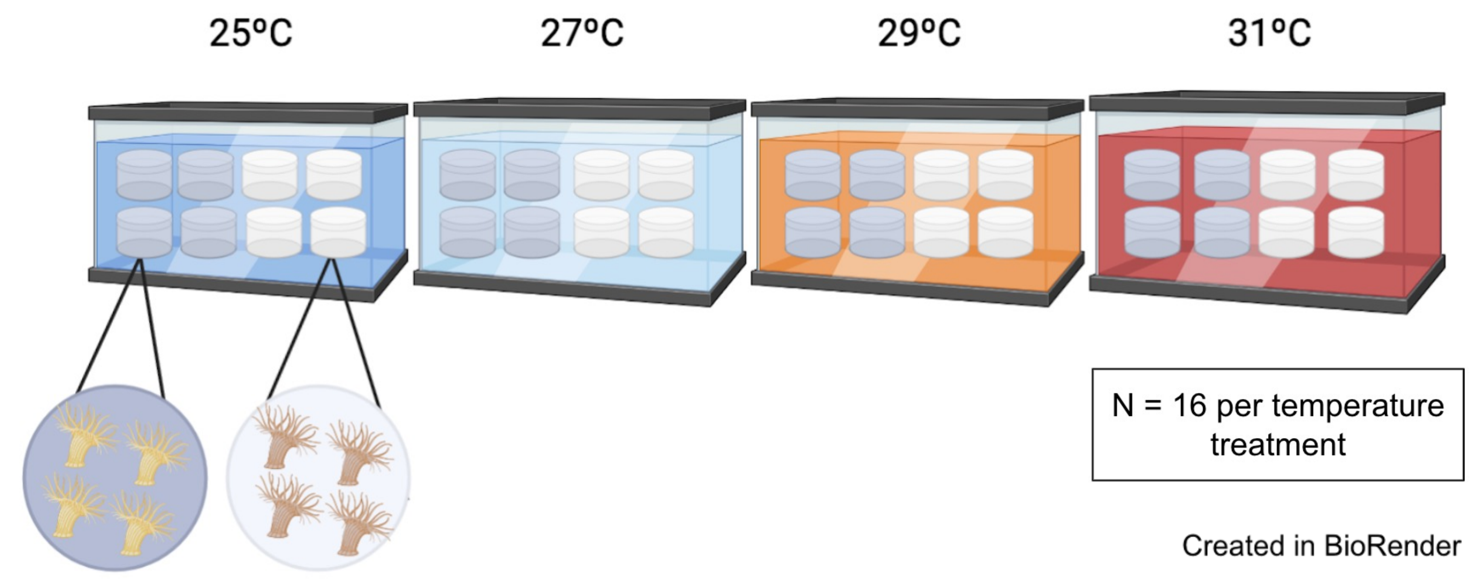
Magenta = chlorophyll from alga
Orange = SNARF (pH indicator dye staining host cell)

pHi: an important metric of acid-base homeostasis

- pHi indicates the cellular response to heat stress
- Bleaching susceptible corals have lower pHi than bleaching-resistant corals
  - Bleaching phenotype impacts pHi, although neither fully recovered

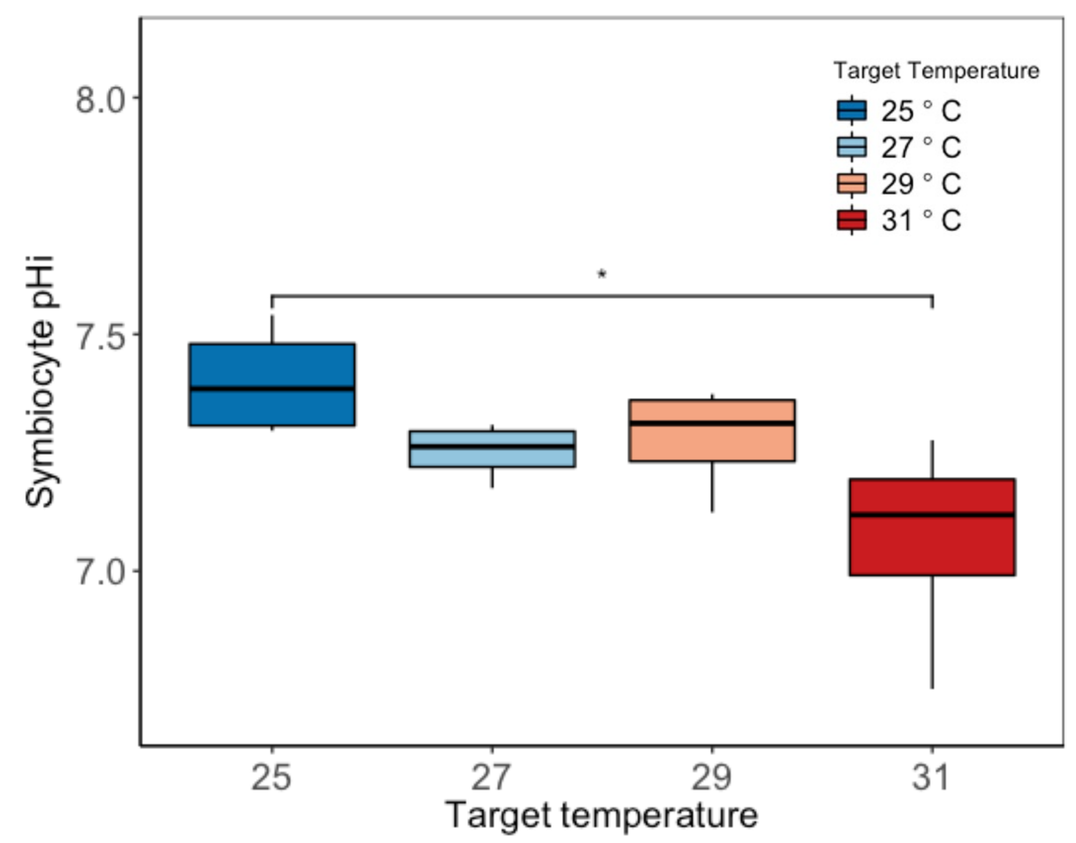


Experimental Design



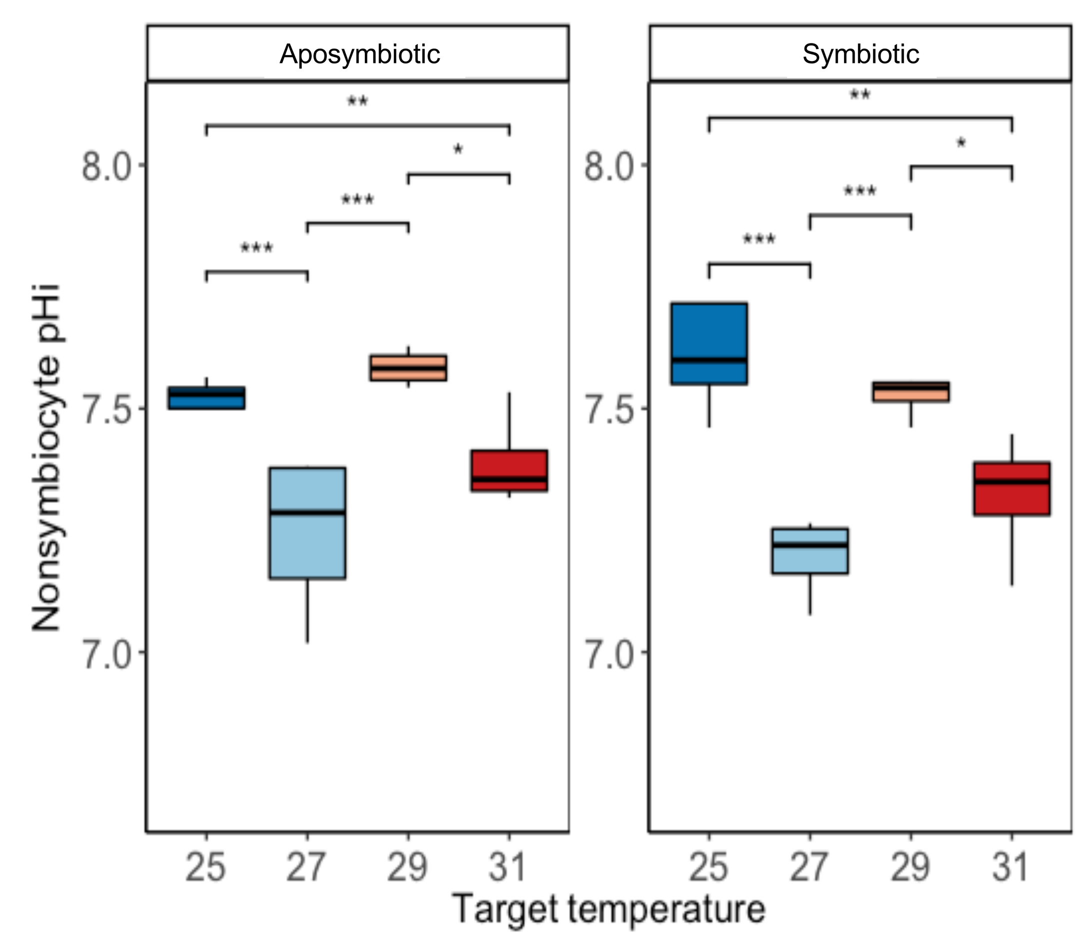
In May 2022, we subjected aiptasia to a sub-lethal, 2-week heat stress experiment across four temperature treatments. Four biological replicates in each container were used to conduct physiological assays for protein content, chlorophyll content, symbiont cell counts, carbon incorporation, and pHi.

pHi decreases in response to heat stress



pHi was measured in the dark.

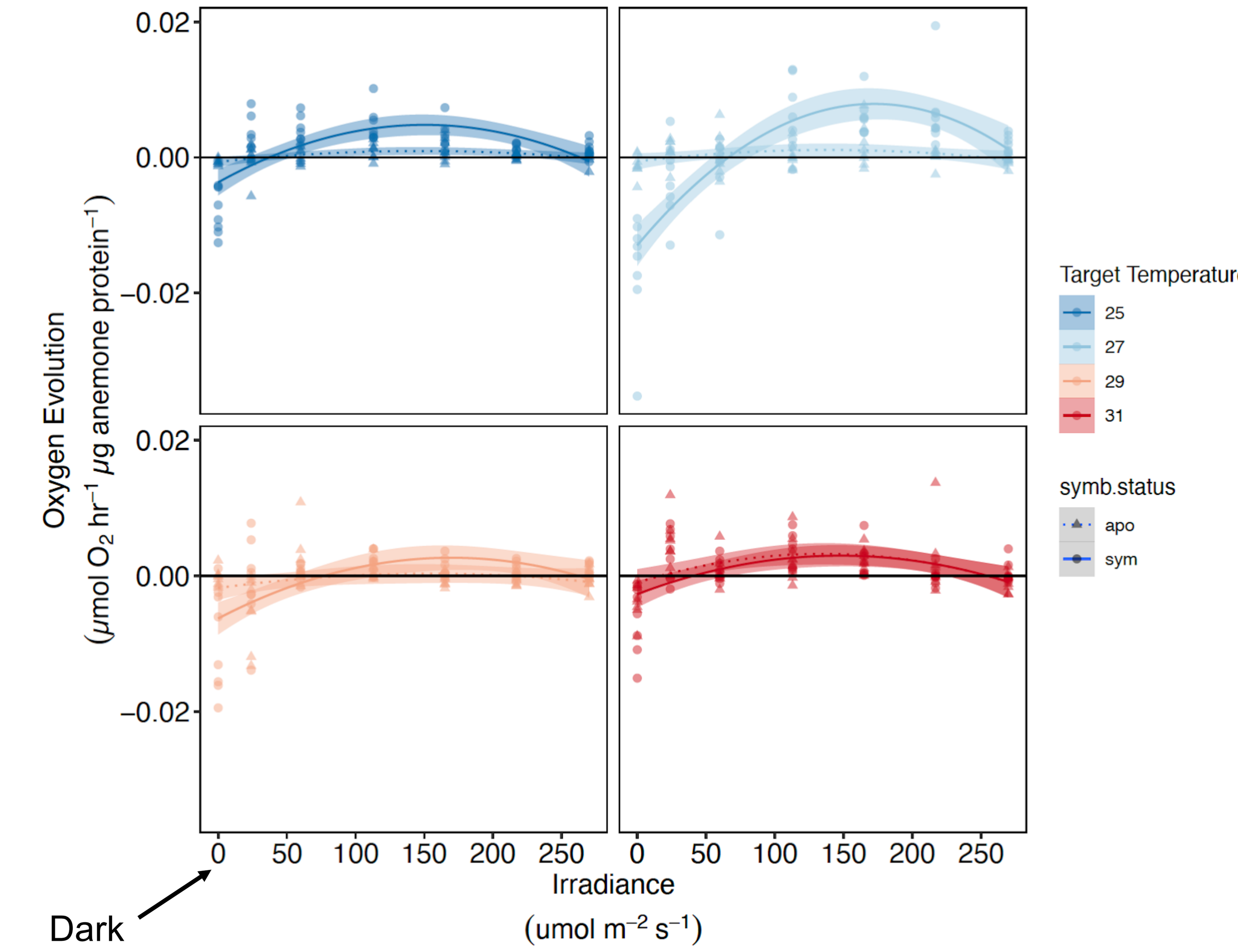
For symbiocytes (cells that contain algal symbionts), there was a step-wise decrease in pHi across treatments. This indicates a strong <u>effect of temperature</u> on acidifying the pH.



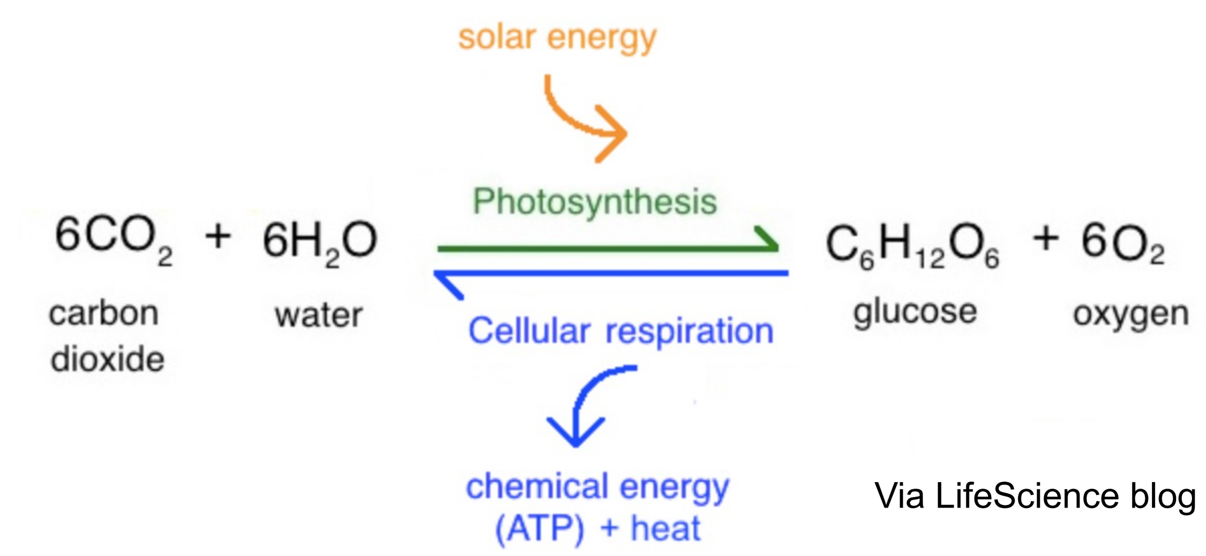
For nonsymbiocytes (host cells without algae), we also observed cellular acidification in the hottest treatment. The same trends occurred between apo- and symbiotic anemones, suggesting that <u>temperature rather than bleaching influences this trend</u>. These trends differ from the symbiocytes.

Between symbiont status, there is a surprising dip in pHi within the 27ºC subset. We theorize that the mechanisms for acidification are not the same between 27º and 31º groups.

Respiration + Photosynthesis



- In the dark, only respiration occurs, resulting in a negative rate as O_2 is consumed. In the light, symbiotic algae produce O_2 during photosynthesis, resulting in a positive rate
- Photosynthetic rate increases w/ light level until inhibition point
- 27º treatment has the most negative slope in the dark (most respiration) and the most positive slope at the optimal light (most photosynthesis)



Via LifeScience blog

Preliminary Conclusions

Previously, we had thought that there might be a relationship between pHi and bleaching. However, from our data we now hypothesize that heat stress has a more direct relationship with pHi. This is due to the consistent pHi trends in apo- and symbiotic anemones. The mechanism for pHi regulation is still unknown, however might point to a host-central explanation. Other physiology parameters like host carbon isotope assimilation from photosynthesis might help tease apart this ambiguity.

The 27º treatment appears to be optimal for photosynthesis, as it has the maximum rate of oxygen production. In combination with the pHi data, we are trying to understand this interesting effect of temperature. Currently, our hypothesis is that the high rate of respiration can help explain the acidic drop in pHi. Respiration and photosynthesis peak at 27º, meaning that there is more of a buildup of CO_2, which acidifies the cell.